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THE SURGICAL CLINICS OF NORTH AMERICA

APRIL, 1921

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CONTRIBUTORS TO THIS NUMBER

FRED H. ALBEE, M. D., Professor of Orthopedic Surgery, New York Post-Graduate Medical School and Hospital; Attending Orthopedic Surgeon, Post-Graduate Hospital, etc.

LEO BUERGER, M. D., New York Polyclinic Medical School and Hospital.

JOHN F. ERDMANN, M. D., Professor of Surgery, Post-Graduate Hospital and Medical College; Attending Surgeon, Post-Graduate Hospital.

CHARLES L. GIBSON, M. D., Professor of Surgery, Cornell University Medical College; Attending Surgeon, New York Hospital.

JOHN A. HARTWELL, M. D., Assistant Professor of Surgery, Cornell University Medical College; Director of Surgery, Cornell Division, Bellevue Hospital, New York.

CHARLES GORDON HEYD, M. D., Professor of Surgery, New York Post-Graduate Medical School; Attending Surgeon, New York Post-Graduate Hospital; Consulting Surgeon, Greenwich Hospital, Greenwich, Conn.; Consulting Surgeon, Morristown Memorial Hospital, Morristown, N. J.

KENNETH JOHNSON, M. D., Instructor in Surgery, Cornell University Medical College.

WALTON MARTIN, M. D., Associate Professor of Surgery, College of Physicians and Surgeons, Columbia University; Attending Surgeon, St. Luke's Hospital; Consulting Surgeon, White Plains and Loomis Sanitariums.

WILLY MEYER, M. D., Emeritus Professor of Surgery, Post-Graduate Hospital and Medical School; Attending Surgeon, Lenox Hill Hospital.

EUGENE H. POOL, M. D., Attending Surgeon, New York Hospital; Associate Professor of Surgery, College of Physicians and Surgeons, Columbia University.

FORDYCE BARKER ST. JOHN, M. D., Associate Professor of Surgery, College of Physicians and Surgeons, Columbia University; Director of First Surgical Division, Columbia University, Bellevue Hospital.

BYRON STOOKEY, M. D., Assistant Surgeon, Neurological Institute; Associate in Neurosurgery; New York Post-Graduate Medical School and Hospital; Instructor in Neurology, Columbia University.

ALLEN O. WHIPPLE, M. D., Presbyterian Hospital.

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THE SURGICAL CLINICS
OF
NORTH AMERICA

VOLUME 1 NUMBER 2

CLINIC OF DR. JOHN F. ERDMANN

POST-GRADUATE HOSPITAL

EXOPHTHALMIC GOITER

THE first patient is a woman thirty-one years of age who has been in the hospital under observation for ten days. She gives the following history:

Chief Complaint.—Choking sensation, change in voice and nervousness.

Family History.—Negative for goiter, tuberculosis, and cancer.

Past History.—Scarlet fever when a child, very sick. Influenza in 1918 and again in 1919. Nervous breakdown in 1915, which required residence in the country and careful treatment for one year.

Symptoms at that time were: weakness, severe headache, and insomnia.

Personal History.—Menstruation began at twelve, regular, one and a half days, small amount. Since marriage regular, two and a half days, moderate. No change with the present condition. Married eight years, with two full term and one seven months' pregnancies.

Present Condition.—In 1917, shortly after the second child was born, the enlargement of the neck was first noticed. There has been a gradual increase accompanied by the following symptoms in the order of appearance: Hoarseness and a change in the quality of the voice; weakness, to the present exhaustion; sweating from the least exertion, profuse at present; itching of skin, troublesome at times; diarrhea for six months, in attacks of one week to ten days, no blood in stools; palpitation from exertion

and excitement is becoming rapidly worse; shortness of breath when climbing stairs, particularly in the last two months; weight loss, 90 pounds in four years; hair has been falling out in large quantities for six months, and has become straight and fine.

Physical examination on admission to the hospital:

General Appearance.—Unduly excited by introduction, worried, looks frightened, face flushed and cheek bones prominent, eyes protrude and pupils are widely dilated. Movements are rapid, inclined to be jerky, talking seems to tire patient quickly, the voice is unnatural and weak.

Head.—Hair is very fine, thin, dry, and lifeless. Eyes are prominent, von Graefe's positive, pupils dilated, equal, and react normally to light and accommodation, tension equal, movements normal. Mouth: teeth have had poor repair of large cavities, bridge-work in poor condition. Larynx: cords slightly granular in appearance, movements normal, no paralysis, change in voice not due to anything detected by indirect examination.

Neck.—Typical thyroid enlargement, right lobe size of lemon, smooth, and generally enlarged; left lobe visible. Pulsation of tumor visible, moves with swallowing, freely movable from side to side, equal consistency throughout, soft, and non-fluctuant. Bruit heard over right lobe distinctly.

Heart.—Normal size, sounds of good quality, occasional extrasystole. Systolic murmur at base.

Lungs.—Expansion equal, no consolidation, generalized bronchitis. Sputum negative for tuberculosis. Alveolar CO_2; tension 45.

Abdomen.—Negative.

Extremities.—Cool and moist. Reflexes normal. Pulse 120, small and easily compressible. Blood-pressure: 165 systolic, 90 diastolic.

Basal metabolism: Nervous and excitable; poor co-operation. Rate of 60.

The patient was placed in bed immediately in a quiet room with a special nurse. There is little that affects the reduction of toxemia in these patients beyond rest and comfort. Suggestion by the nurse and doctors plays no little part in securing rest and

putting the patient at ease, and every opportunity to encourage the patient as to the outcome of the treatment should be taken advantage of.

An ice-bag has been applied to pericardium, two hours on and two hours off, for past week.

The only drugs administered have been triple bromids, grains xx, t. i. d.; codein, grain $\frac{1}{4}$, for cough when troublesome at night, and a mild cathartic pill to keep the bowels open. Diet has consisted of the routine hospital meals with restriction of fats for the past few days. The patient has been encouraged to drink water freely. Ice-cap to heart, two hours on, two hours off.

Tenth day following admission:

General Appearance.—Quiet and rested, bright and cheerful. Anxious only to have the operation over.

Temperature 99.4° F. (rectal). Pulse 100, regular, of good quality. Blood-pressure 150/90. Metabolic rate 45. Normal 37.5. Examination of urine negative.

Preparation for Operation.—Day preceding: Soda bicarbonate 15 grams by mouth. Pulv. glyc. 3 drams. Tap-water 1000 c.c. by rectum unless the patient is disturbed. This patient took 750 c.c. while sleeping last night. Neck is prepared by shaving only, when this is necessary.

Day of operation: Light breakfast for afternoon operation. Small S. S. enema three hours before operation. No lunch is given, but tea or water may be taken until one hour and a half before operation. One hour before operation, morphin, grain $\frac{1}{8}$, and atropin, gr. $\frac{1}{50}$.

Anesthetic has been nitrous oxid and ether, closed method. Pulse at the beginning of operation 120, color good, breathing quietly.

Preparation of field: One application of 3.5 per cent. tincture of iodin.

Position: Dorsal, small sand-bag under shoulders, chin up, head back.

Operation (Dr. Erdmann).—I make the usual collar incision, here taking care to place the incision low, so that it may be

covered later by the ordinary string of beads. You will notice that I cut through skin and platysma to the muscles before I begin reflecting the flap upward. There is considerable bleeding in this case, as is usual in cases of hyperplasia. By separating the muscles the entire length of the reflection I hope to be able to deliver the gland without cutting across the muscles. The gland with its capsule protrudes into the separation; it is not adherent to the capsule which strips away readily. I am delivering this right lobe with some difficulty; as it is considerably enlarged, however, I will not have to divide the muscles. The lower pole is the most accessible, and I begin by clamping the blood-supply here, leaving a part of the gland and all of the posterior capsule to avoid injury to the parathyroid and recurrent laryngeal nerve. The isthmus is enlarged and we will remove that in the same way. Now we will tie off these clamps and then examine the left lobe again. The left lobe is not cystic, nor is it enlarged to any extent.

This gross specimen has some parts that appear colloid, and in other parts it is quite hard or hyperplastic. I do not wish you to think for a moment that it has the marks of malignancy, but they are marks of typical hyperplasia. Dr. Carter in sewing the wound is going to take in the deep fascia with the platysma, so there will be a much better scar. The drainage we place in will be allowed to remain forty-eight to seventy-two hours. It is extremely essential, in suturing the skin, that you do not puncture the jugular veins, as the hemorrhage is so severe that deeper sutures would have to be removed to control the bleeding.

We will give this patient immediately upon going to bed in the ward or room 1000 c.c. of tap-water containing 1 ounce of bicarbonate of soda and $1\frac{1}{2}$ ounces of glucose, in a Murphy drip, and a sufficient amount of morphin to control her absolutely. The patient is apt to be excitable and she may require anything from $\frac{1}{3}$ to $\frac{1}{2}$ grain. We will start her with $\frac{1}{6}$ grain. She should have her preliminary before the operation. Hyperthyroidism following operation ends fatally, if at all, at the end of a few hours, usually in eighteen to twenty-four. The patients develop a high temperature between twenty-two to twenty-three hours

postoperative. It is rare to have a postoperative hyperthyroid case die on the second or third day. The pulse now is 118, color is good, and respiration is easy and smooth.

The postoperative temperature sheet is reproduced here, showing a recovery of a borderline case. Twenty-three hours after operation the patient became very restless, not irrational,

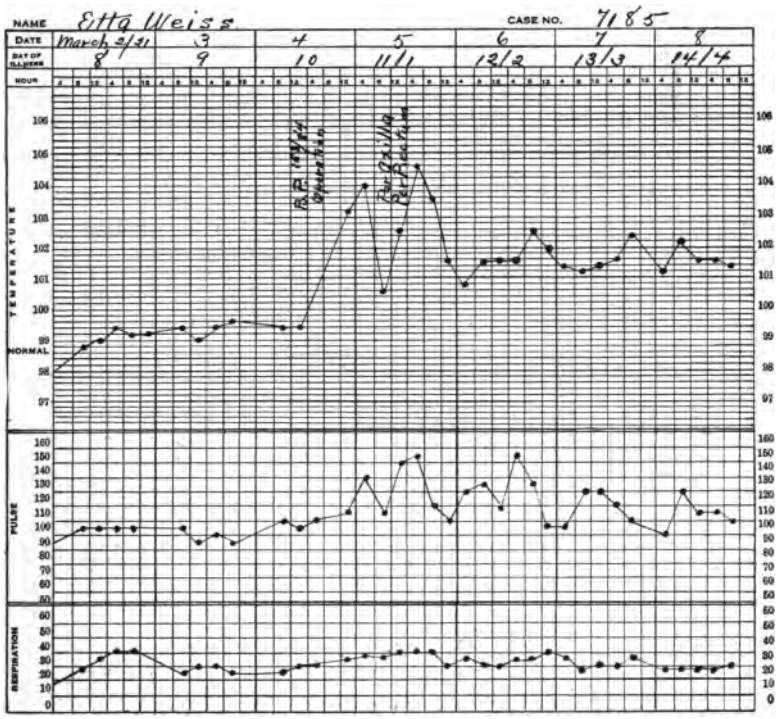

Fig. 113.—Case I.

and the temperature rose to 104° F. She received $\frac{5}{8}$ grain of morphin in the first twenty-four hours. She did not retain the Murphy drip, so it was discontinued, and fluids were given by the mouth and retained. In the second twenty-four hours the temperature again rose to 104.6° F., with extreme restlessness. The pulse was rapid, intermittent, and of poor quality. Ice-bags were applied to each groin, pericardium, and to the head.

Morphin, grain $\frac{2}{3}$, and sodium bromid, 130 grains, was given during the twenty-four hours. The bromid will control the restlessness better in some cases than morphin, and in this case it was so. The temperature did not rise above 102° F. again, the patient quieted down, and the pulse gradually came down to an average of 85 when the patient left the hospital on the twentieth day.

Pathologic Examination of the Tissue.—Gross: Total weight 27 grams. The exterior is lobulated, but covered by smooth membrane. On section it is fleshy throughout and rather firm.

Microscopic.—Sections show in part thyroid acini, more or less dilated by colloid material. Some areas, however, show edematous hyperplasia with tendency to papillary formations of the epithelium lining the acini—a hyperplasia usually associated with exophthalmic goiter.

Diagnosis.—Goiter, partly colloid and partly Graves in type.

CYSTIC ADENOMA OF OVARY

THE next patient is a woman fifty-four years of age who complains of a rapidly growing tumor of the lower abdomen. She gives the following history:

Chief Complaint.—Tumor of lower abdomen. Duration five months.

Family History.—Negative for cancer and tuberculosis.

Past History.—Operation ten years ago for a mass in the abdomen, appendix was removed at that time. Another operation seven years ago, when something was done to her tubes, ovaries, and uterus, but just what she was unable to tell us. Pneumonia nine years ago, sick in bed for three weeks.

Personal History.—Married, three normal children, four miscarriages. Otherwise normal.

Present History.—Attention called to abdomen by the size of mass five months ago. Has increased rapidly in size, accompanied by hemorrhage from vagina, beginning one month after the onset and lasting for thirty days, profuse for first few days, with rapid diminution. Frequent urination for six months; very frequent and small in amount at present. Backache and dragging sensation in pelvis for three months. Constipation for six months. Fatigue very noticeable of late. There has been no loss in weight, and, in fact, she states there has been a gain (probably due to the tumor).

Physical examination on admission to the hospital:

Heart.—No enlargement, regular, no murmurs heard.

Lungs.—Normal expansion, no râles, dulness, or adventitious sounds.

Temperature, 98.6° F.; pulse, 80; respiration, 22. Blood-pressure, 140/110.

Urine Examination.—Normal.

There is a scar from the appendicular operation and a scar from the section. The enlargement is that of a seven-month

pregnancy. The tumor is large, solid, and seems to be more to the right side than to the left; it is exceptionally elongated.

On vaginal examination I am quite sure that I can push the tumor up, although it does not fluctuate. I am quite sure, also, that I can map out the body of the uterus, so that it has got to be either a multilocular cyst under tension or some other cyst. When I say some other cyst I have in mind a case I operated upon about one year ago, in which we removed a large tumor from the pelvis which we could not dislocate at first, and even after the patient was put in the Trendelenburg position we could not dislocate it. As soon as we opened the abdomen the tumor disappeared entirely from sight; there was no question of fluid or anything of that sort. I put my hand in the abdomen and found it up under the costal arch, retroperitoneal, and that it involved the pancreas—a pancreatic cyst. That is the reason why I say some other cyst or tumor.

You see that this abdomen looks like a pregnancy of fully six months, almost seven, and the mass is more on the right than the left, and the way it rises above the umbilicus. The abdomen was shaved last night and is now being prepared by the application of iodin (3½ per cent.). Here is the scar of the appendix operation, and here the scar of her previous uterine operation, and I believe that we will find considerable adhesions; if we do not we will be agreeably disappointed. I am making an incision through the midline disregarding the old incision, and I make a liberal incision for several reasons. If this is a cyst, the possibility of its being malignant is very sure, and to rupture a malignancy in these days is not surgery. It will be far better to make the incision deliberately long and not run the risk of spreading the process of the growth, if one is present. Papilloma of the ovary may be highly malignant, and, again, of semi-malignant character, but the tendency is to be malignant. This is a multilocular cyst and possibly a cystopapilloma. Note the multiloculations. So far we are fortunate in not having adhesions, and the cyst delivers easily. That is something for an artist—with the full twist of the pedicle from the right to left. As a rule, these cystopapillomata of the ovary are bilateral.

This patient has nothing but a small fragment of the ovary here, the remains evidently from the former operation. There is no information concerning that fragment, but you will also see here at practically the midpoint a small band of adhesions, where there evidently was an operation for ventral fixation.

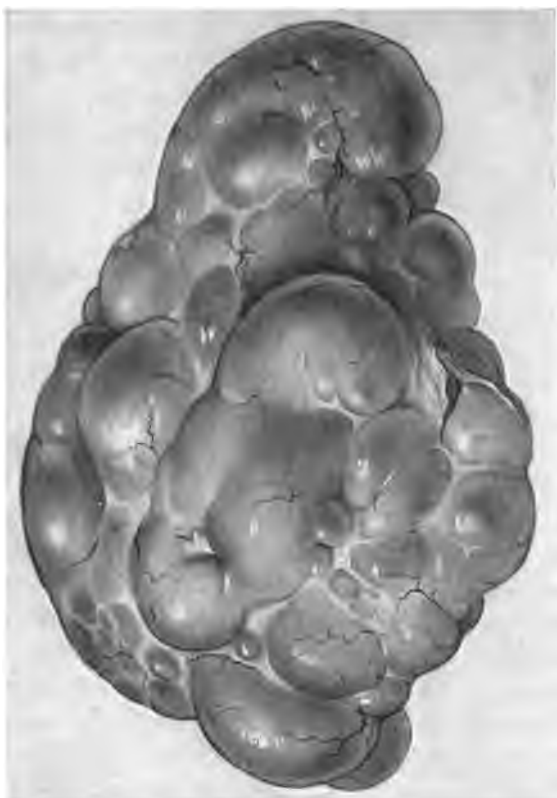

Fig. 114.—Case II. Multilocular cyst. Cystopapillomatous ovary.

After releasing the twist in the pedicle we clamp across below the twisted area and cut the cyst free. Now, instead of tying this pedicle off *en masse*, we sew over the forceps with a non-lock stitch, not drawing the suture tightly, but firmly. When we come to the end we release the thread and then quickly draw the slack in our suture. Then we retie it in case there is any bleeding.

I would like to call your attention to the attenuation of that fixation, how it has failed by a process of time. It forces the uterus into the position from which it was originally intended to separate it. This failure is due in part to the pressure from the large tumor above down upon the uterus. I think with the tumor out there is no need of shortening that in any way. The uterus appears to be normal. The appendix has been removed with inversion, no stump remains. The gall-bladder is normal.

For closure of the peritoneum I am using a No. 2 iodinized catgut, and I will run back with this to draw the muscles together. Then with a No. 2 chromic catgut, single strand, I will close the fascia. One silkworm-gut stitch for retention, and silk for the skin, using a lock stitch.

The patient has received little or no shock from this operation. The pulse is now 105, regular, and of good quality.

The anesthetic has been gas for induction, followed by ether, closed method. There was no preliminary injection of morphin in this case, and you see the anesthetic could not have been smoother. I use morphin as a preliminary to anesthesia only in goiters and cases for gas anesthesia.

This patient will be given morphin, grain $\frac{1}{6}$, as soon as signs of consciousness appear, and grain $\frac{1}{8}$ thereafter as often as necessary for the next thirty-six hours. Fluids by mouth, preferably tap-water, after six hours. Soft diet after eighteen hours if there is no vomiting. Enema for distention p. r. n., and catharsis as soon as needed after thirty-six hours. Unless the patient runs a temperature that cannot be accounted for, has pain in or a discharge from this wound, the dressing will not be disturbed for nine days. Then the sutures will be removed, and with primary union the wound will be inspected on day of discharge. She will be allowed to sit up on the ninth day, get out of bed on the tenth, and go home on the twelfth day.

I shall not be a bit surprised if the laboratory reports that specimen as malignant. If it is malignant the prognosis is absolutely good, for there is nothing in the pedicle at all. In cases of cystopapillomata of the ovary patients in many instances are prone to live for years.

It was in a case somewhat similar to this that the late Dr. Hodenpyl happened to be in the right position to remove the fluid, and the patient's improvement was so great that he thought something or other in the way of a serum that was autogenous from the patient might be of value to other cases. For some time subsequently he treated her with serum, and at the same time injected her serum into a number of other cancer cases, and, as is the case in all new remedies, these patients became buoyed up very much. They reported feeling better and he began to regard the cases of cancer as cured. Then, after a time, the reports began to come in that the serum was not a success. Just about that time Dr. Hodenpyl was taken ill, and when he received the news he was very much disheartened, and I feel his death was hurried by the disheartening news of his supposed cure.

I recall a patient with bilateral cystopapilloma operated upon at Mt. Sinai Hospital; six months later the patient was suffering so severely that something had to be done. We brought her down here and removed a cystopapilloma fully the size of a cocoanut from each side. That was five years ago and she is still well.

There are other types of cystopapilloma which are exceedingly vicious. I remember one case of a woman thirty-six years of age in the Roosevelt Hospital. She had bilateral cystopapillomata, and each one was about the size of a large grapefruit. She oozed serum as though she had been cut, and was bleeding so that it was impossible to keep the bed clean. We had put some drainage into her over night, and by the next evening the woman was practically exsanguinated from loss of serum. She died at the end of the fourth day.

Then we had a woman thirty-eight years of age who had a ruptured ovarian cyst which was a cystopapilloma, in whom I did an operation for intestinal obstruction, and found a mass of fluid, a large capsule, and a cyst. Eight months afterward she had a secondary deposit along the line of the incision. She died within a period of sixteen months from the time of the rupture of the cyst.

A few years ago I removed a cystopapilloma from a woman sixty-four years of age, and eight years after that she had a cystopapillomatous secondary growth in the scar of the abdominal wall, which demonstrates the length of time a patient can go without secondaries, and even if they do have secondaries, they may be mild in character.

Pathologic Examination.—*Gross.*—Cyst measures 25 x 20 x 10 cm. and weighs 2300 grams. It is thin walled, translucent, and lobulated by numerous constricting bands on its surface, which is generally smooth. On section, it is multilocular, most of the spaces being filled with a thin orange-yellow fluid, but in some it is relatively thicker and stringy. There are no papillary areas found. The inner surface is pale and smooth everywhere.

Microscopic.—Sections of cyst wall show a smooth outer surface with a wall of fibrous tissue and many irregular septa extending inward, interlacing and enclosing the cystic spaces. Some of the cysts are lined by a single layer of columnar cells, others by flattened cells. The septa contain blood-vessels and are somewhat infiltrated by round cells. There is no proliferation of epithelium at any point.

Diagnosis. Multilocular cystadenoma of ovary.

The patient made an uneventful recovery, wound healed by primary union, and she left the hospital relieved of all symptoms except moderate constipation.

DUODENAL ULCER

THIS case is one of suspected duodenal ulcer. The patient has had pain in the abdomen for ten years, varying in time and intensity. The periods in which he is well are longer than the periods in which he is ill. That is one of the usual symptoms in cases of this kind. They have periods from six weeks to four or five months, or longer, in which they are well. The distress is from three to four hours after eating, varying in character, and accompanied by gas. He has been put on bicarbonate of soda to relieve the burning and gas. There is no vomiting, except by induction, all of which is characteristic of duodenal ulcer. Recently this patient has found that practically any kind of diet upsets him, whereas formerly only certain foods would. One year ago a gastro-intestinal specialist had him *x*-ray and advised operation.

On February 26th an examination revealed a tenderness over the duodenal zone, and also over the zone of the appendix. Yesterday he had quite a bad period, so now without any further examination by the *x*-ray we are going to do an abdominal exploration.

We make the duodenal incision in the rectus muscle or else between the inner third and the outer two-thirds. We have made our dissection between the inner third and the outer two-thirds of the rectus. The man has a very large ulcer at the duodenum, and just a fractional amount of infiltration. There is considerable obstruction, as you will see. That is only one-third of the stomach which I have out. A gastro-enterostomy will be indicated here unless we can do a Horsley operation. Sometimes when we anesthetize patients the stomach distends, and it is quite necessary to get rid of the gas. In this man's stomach I would like to get rid of the gas before we do anything. Then we might very readily press down the stomach and we

can very readily bring up the duodenum. The doctor says he was washed out before he came up, but there is evidently a great deal of acute dilatation, or he is taking in a great deal through the esophagus instead of through his lungs.

Now we have a collapsed stomach here, and here is the colon, and here let me show you the prettiest ulcer that has ever been shown in this room. Note the infiltrated area with indentations, and note the vein showing the position of the pyloric sphincter. Now in this ulcer the entire diameter is less than the end of the little finger. This is the type of duodenal ulcer and complications in which we get the best results by doing a gastro-enterostomy. We have an obstructed condition and all we need is to do a gastro-enterostomy. Take and throw over the transverse colon, and we will then obtain a very easy dislocation of the stomach into this opening I am making in the transverse mesocolon. We dislocate the stomach and grasp it with a pair of forceps in the lowermost portion, although it is the highest portion of the stomach as we see it here. We are going to clean off these adhesions, and then by making tension on your transverse colon you will observe at this point the ligament of Treitz, and to the left of it that we have a fixed portion of the duodenum. We will make an anastomosis between the first portion of the jejunum and the stomach from left to right. The next step is to place your transverse colon into the abdominal cavity, and bring up the stomach. Cover up the field well with pads moistened with saline. Then we take Kocher clamps and grasp the stomach and intestine. Wall off everything very carefully with sponges, and then we begin our anastomosis by sewing the apposed surfaces of the stomach and intestine together with chromicized catgut. The primary stitch is the ordinary basting stitch. There is nothing fancy about this stitch; at least no fancy stitch is necessary. Neither do I make it my particular aim not to sew through the stomach and intestine. People do not die of infection in this operation. They die of pneumonia more than anything else, unless the operation is a bad one. When you come to one end of it wrap the needle twice, and that gives you a knot or a half-knot in your stitch.

Next we cut the opening into the stomach and the opening into the intestine, going about ¼ inch from the point of anastomosis or suture. Now to give you the picture to show you what we have, I will pick up the apposed surfaces of the intestine and stomach at this point. There we have an opening of about 2½ inches in length; here is the mucous membrane of the outer wall of the intestine; here is the mucous membrane of the upper or anterior wall of the stomach. The appendix lays well down over the promontory against the sacrum and is bound down very badly. As long as we have it we will remove it, because the appendix is in itself a gastric disturber, and is said to be the cause, by means of infection, in many instances, both of gall-bladder disease and duodenal and stomach disturbances. I crush the base in every instance that I can in order to obviate the possibility of hemorrhage which results from turning in an open appendix. I am in the habit of crushing and ligating to obviate trouble of that sort. You place a purse-string suture ¼ inch from the base of the appendix, bathe the cut stump with pure carbolic acid, and invert it.

Here we have had a large ulcer of the pylorus, and have done a gastro-enterostomy from left to right, and found a chronic appendix which we have removed. This man's treatment will be ⅛ grain morphin, Fowler position, a Murphy drip of 1000 c.c. containing 1½ ounces of glucose and bicarbonate of soda. He will have nothing by mouth for twenty-four hours. If he vomits he will be washed out. Should the pulse begin to climb very fast within a few hours we will know that there is hemorrhage. We have had hemorrhage from this operation about five times within fifteen years.

The abdomen will be closed with plain No. 2 for the peritoneum and muscles and chromic No. 2 for the fascia. No drainage used.

The patient made a good recovery, no vomiting after operation. Left the hospital able to take all foods except heavy meats with no gastric discomfort.

Pathologic examination of the appendix shows chronic appendicitis.

CHRONIC SUPPURATIVE MASTITIS

THE next case is that of a woman forty-four years of age who has had a discharging breast for the last two years, and during which time she states she has had thirty-two abscesses. You will see she has a sinus at this point. There are no glands in the axilla and no reason to believe that there is any malignancy, except from induration, which it is possible to get in septic mastitis, which she has evidently had. Her last child was born two years ago and she had no milk in the right breast; the child nursed only from the left. Two years ago the right breast swelled without discharge for a time, but since then she has had seventeen abscesses in this breast, which were cut. Two days ago it swelled up again, the patient had chills and fever for a time, and then the breast began to discharge. In these mastitis cases occasionally the breast must be amputated, although that is rare. Every now and then we find a case which has come to the point where amputation must be considered, and then excision of the breast will cure it. Three years ago I had a case with a number of abscesses actively discharging, and the only thing we could do was to remove the entire breast. In some instances the cases are cured after a liberal dissection within two and a half to three weeks. This patient does not present a picture of seventeen abscesses. There are only two scars, but possibly there may be a foreign body left in with one or both of these.

We will not do a radical operation, but will simply lift the breast from the pectoral muscles, unless the tissue looks malignant. It does not feel so. We will remove this breast with the Stewart incision, which begins at the median line or beyond the median line, extending it across the posterior middle portion of the axilla, and we will do a very rapid dissection. I will make the incision in the breast. There is a sinus at that point, and something that looks like more pus here. Under ordinary circumstances I would think it was malignant, but there is

nothing at all that looks anything like malignancy. There is absolutely nothing in the glands. But we have a suppurative mastitis which would never have gotten well without excision of the sinus itself or excision of the breast. We put in a ¼-inch caliber rubber drainage-tube, and put in three silkworm sutures, and then sew it up with silk.

This incision of Stewart's is used in removal of the breast in a radical operation, just as well as it is in operations of this kind. I have personally done over 100 operations in malignancy and non-malignancy using this incision. In the first 25 there were a large number that complained of exceptional pain in the axilla. Whether we were just anxious about the patients and recorded pain more frequently I do not know. But after the first 25 the patients did not seem to be complaining of much pain, at least not as much as in the first 25. The incision is all right for certain locations of the tumor. After that the modified incision of Meyer and Halstead or the incision of Rodman will give better exposure, more than does the incision of Stewart. I would rather do a Willy Meyer-Halstead operation than this type.

Pathologic Examination of the Tissue.—*Microscopic.*—Sections from three areas show the same picture. There is degenerating fibrous tissue heavily infiltrated by polynuclear cells. The exudate is so extensive that recognition of fixed tissue cells is difficult. There is extensive proliferation of endothelial cells. No mammary gland tissue is seen in the sections.

Diagnosis.—Chronic purulent mastitis.

Discharged to the out-patient department on fourteenth day with considerable seropurulent discharge.

CHRONIC CHOLECYSTITIS

THE next patient is a woman thirty-six years of age, with pain in both sides—right high up, left lower down. Also backache and pain in abdomen during the night, usually about 2 o'clock in the morning. Has never had pain of great intensity while awake. The pain is usually worse in the evening between 5 and 7 o'clock than during the day, but she is bothered much more in the night time. There has been no vomiting. Examination shows patient to be markedly tender over the gall-bladder and appendix, and there is a retroposition of the uterus, with slight ulcers of the cervix. I am going to expose her for an appendix and an exploratory gall-bladder at the same time.

In this case there is a possibility of finding a diseased gall-bladder or appendix, or both, and instead of making the incision for a gall-bladder or appendix, we make it between the two points, that is, a low gall-bladder incision or high appendix incision, which will allow us to go up or down as the condition demands. In other words, if we see that the gall-bladder is involved, we can extend the incision upward, and if it is the appendix we can extend our incision downward. We will make it in the midportion of the rectus. That will give a free entrance to the gall-bladder for palpating or visualizing, and also for palpating or visualizing the appendix. We will make a Deaver incision. The first thing we do is to examine the gall-bladder. It is normal, white, and I do not find any evidence of stones. Unless there are adhesions to the gall-bladder I am not going to take it out, so that we will extend our incision upward until we can see the gall-bladder. It is a peculiar pearly gray and has not the appearance of a normal glistening gall-bladder. We have the appendix low down in the pelvis. It is pathologically pink and white, and there are some bands and adhesions also at this point. The first step is to release the adhesions, which are dense in this case. Now I will do a routine appendectomy, just as you saw me do in the other cases.

Coming back to the gall-bladder, we will now proceed to wall off the abdomen with moist pads, so that we can do a cholecystectomy.

I remove this gall-bladder because of the peculiar pearly gray appearance, which is decidedly abnormal, and the definite history of past gall-bladder attacks. Although there is no evidence of stones here nor has there been any symptoms in this case of involvement of the gall-ducts by stones, I believe the pathologist will report a diseased condition of this mucous membrane, and there is one operation for uncomplicated cholecystitis in this clinic—cholecystectomy. We are getting away from the "Stone Age" in the surgery of the gall-bladder and coming to depend more upon the appearance, adhesions, and glandular enlargement about the cystic duct for information regarding the past inflammation and future history. The effect upon the biliary system from removal of the gall-bladder is still unsettled experimentally, but we have known for years that removal produces no subjective symptoms.

With a clamp on the fundus of the gall-bladder it may be used as a tractor to dislocate the liver, giving free exposure of the cystic duct region. Grasping the hepaticoduodenal ligament between thumb and index-finger of the left hand, with the gall-bladder resting in the palm, a longitudinal split is made in the ligament, the peritoneal edges separated, and the cystic duct dissected free, using the index-finger as a guide. By forcing the scissors through the ligament above the duct it is clearly demonstrated to be free, and as the scissors are withdrawn a clamp follows; another clamp is applied above and the duct cut across. Using the clamp across the duct as a tractor, the artery and vein are dissected free and clamped. Now as I dissect the gall-bladder free from the sulcus my assistant will clamp the blood-vessels as they appear in the peritoneal reflection. The first ligature is applied to the duct, No. 2 iodinized catgut, and now from below up we will tie off the branches as they were clamped.

In the majority of cholecystectomies I place a drain of rubber tissue down to the cystic duct, removing it at the end of thirty-six hours. There is no need of a drain in these cases for

infection, but every now and then we see drainage of bile from a ligature slipping, and to save reopening the abdomen in these occasional cases we usually place a small drain in the upper angle. The drain does not interfere with the healing of the sound, as it is removed in thirty-six hours.

Wound healed by primary union; patient left the hospital on fourteenth day.

Pathologic Examination of Gall-bladder.—*Microscopic.*—Sections of gall-bladder show low rugæ in part, with tips of rugæ stained with bile and some hyperplasia at base of glands, with mucus in the crypts. The stroma is infiltrated by round cells and a few polynuclears. There is increase of fibrous tissue between the muscle bundles and beneath the serosa with round cells, and polynuclears in excess in the blood-vessels throughout.

Diagnosis.—Chronic cholecystitis and pericholecystitis.

CLINIC OF DR. WILLY MEYER

LENOX HILL HOSPITAL

THE IMPORTANCE OF POSTURE IN POSTOPERATIVE TREATMENT

WHEN as a young student in medicine I attended the lectures of the late well-known Professor Zenker of the University of Erlangen in the winter of 1877–78, he closed the season's last address to his class with the words: "Remember, gentlemen, prophylaxis, the prevention of disease, is the highest aim of medicine." These words were indelibly engraved upon my memory. During my entire medical life I have watched with the keenest pleasure the evolution of medicine and surgery from this point of view, and have followed with the highest admiration the incessant, often self-sacrificing work of medical men to prevent disease in all the branches of our science. I have also personally tried to do my little mite whenever and wherever possible and to live up to my esteemed teacher's impressive words.

What has been accomplished in the way of prevention of disease is known to all of us and to the world. I will but remind you of Jenner's immortal achievement, the vaccination against small-pox, and the now uniformly introduced successful inoculation against typhoid fever, diphtheria, cholera, even yellow fever, and many other infectious diseases, of which the infecting microbe has been found and cultured. So the entire apparatus set in motion everywhere, in private practice and hospital work, before and during operation, all of what we call antiseptic and aseptic surgery, is nothing but a detailed and determined attempt, founded on definite scientific knowledge, to prevent disease, to render infection impossible.

Now, just as our endeavors in surgery, *pre*-operatively as well as *during* the operation, are important to prevent disease and complicating affections, so must our endeavors be constant *after* the operation, when the patient is being and has been returned to his bed, when after-treatment has begun.

Of the many important factors that here come into consideration I shall at this time pick out just one—"posture." Posture in all its varieties is, to my mind, one of the most powerful means at our command to hasten recovery and avoid complications. Of the various postures introduced into practice I shall this evening consider principally two, which I have practised for a great number of years in hospital and private work, alone as well as combined with others—the slight Trendelenburg posture and Sims' posture, or the latter more exaggerated, the abdominal posture.

The Slight Trendelenburg Posture.—When a patient has successfully gone through the immediate dangers of the operation and the first part of the after-treatment, and he as well as all the others concerned in his welfare feel easy and are looking forward to a speedy and uninterrupted recovery, there is still one treacherous enemy lurking in the background ready to strike at any moment—venous thrombosis.

This thrombosis usually concerns the left femoral vein, following work done by the surgeon in his every-day routine, also one or more of the pelvic veins after operations on organs within the small pelvis and after childbirth.

From a pathologic point of view such blocking of the venous lumen is not a very serious matter. The lower extremities and the respective pelvic organs easily stand the disturbance in the normal return flow of the blood to the inferior vena cava. Collateral circulation is plentiful and the concomitant edema of the extremity—though usually at first greatly alarming the patient and his relatives—subsides after a certain time. Its persistence is very rare. Surgeons are used to ligating the deep femoral vein, for instance, in the operative treatment of the so-called thrombo-angiitis obliterans, and no interference with the ordinary circulation is seen. With aseptic healing a thrombus forms

immediately adjacent to the ligature and usually extends up to the spot where a lateral branch enters the ligated vein. In phlebitis the coagulation does not remain quite as local. The thrombosis forms as far as the venous wall has become inflamed and more or less edema develops in the lower extremity, at least, if the femoral vein is involved. Thrombosis in branches of the internal iliac vein may run on without any external manifestations; an unexplainable tachycardia is taken by many as the only outward sign. If the inflammation spreads to the external branch of the common iliac vein, edema of the leg and thigh may become alarming. I but remind you of the so-called phlegmasia alba dolens after complicated childbirth.

What medical men fear is the clinical sequelæ of the thrombosis: the loosening of a part or of the whole length of the thrombus, which then enters the circulation and is driven as a foreign body through the right heart into the lung. What we fear is this sudden pulmonary embolism, the sudden interruption of the normal physiologic circulation of the blood between the right and the left heart by way of the lung, partially or completely, which sets in like a flash from the blue sky and is absolutely beyond the control of the attending physician.

I spoke before of the thrombosis of the left femoral vein. Why only of the left and not also of the right?

It is a clinical fact that at least 95 per cent. (if not 99 per cent.) of thromboses of the femoral vein occur on the left side; and if both veins become involved, one after the other, that the trouble almost always starts with the left. The reasons for this peculiarity are principally anatomic.

We know from the investigations of the Freiburg pathologist, Ludwig Aschoff,[1] that thrombosis occurs in those portions of the venous system in which the flow of blood is retarded provided micro-organisms circulate within the blood.

With the patient in the usual horizontal posture in bed after an operation, the upper part of the body from the hips up being supported on pillows, there is no place in the body where venous

[1] Aschoff, von Beck, de la Camp, Kroenig, Beiträge zur Thorombosefrage, Leipzig, 1912.

circulation is more impeded than in the groin. Poupart's ligament, often strained, presses upon the femoral vein as it runs across the horizontal branch of the pubic bone. From here on the blood has to run uphill in order to reach the inferior vena cava. Further up, on the left side, the right common iliac artery or the lowest portion of the abdominal aorta crosses the common iliac vein in front of the spine, whereas on the right side

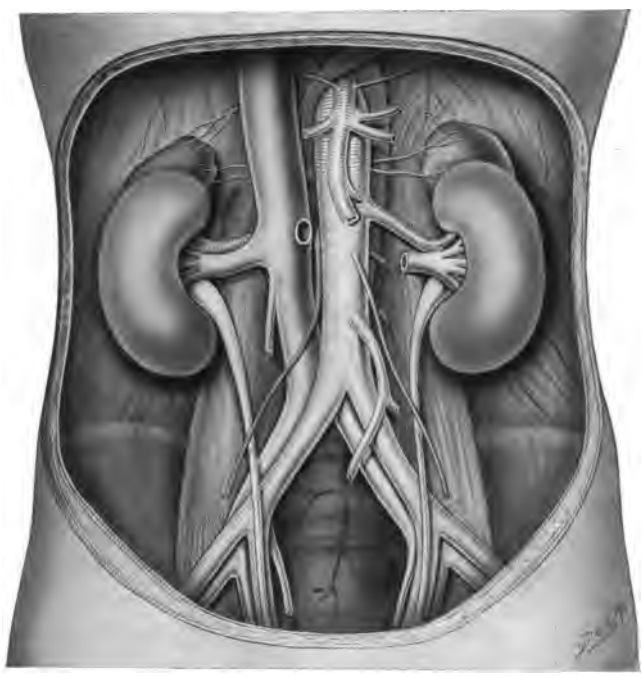

Fig. 115.—The anatomic relation of the crossing of the left and right iliac veins and arteries. (From Heitzmann's Anatomy.)

the external iliac vein passes underneath the external iliac artery, a much smaller vessel, in order to reach the common iliac vein and inferior vena cava. Here also the soft belly of the psoas muscle forms the pillow on which these vessels run. The difference in the circulatory arrangement of the right and left sides is due to the anatomic fact that the inferior vena cava runs

nearer to the median line than the abdominal aorta (Fig. 115). Further, before the common iliac vein reaches the place where it has to pass under the strong and ever-pulsating common iliac artery, the sigmoid flexure of the colon, usually filled with inspissated fecal matter, rests upon it for quite some distance.

These factors have been accused as being principally responsible for the clinical fact that postoperative femoral thrombosis is almost exclusively met with on the left side. It is, of course, possible that in addition to these anatomic conditions minor factors often come into play in its development. Repeatedly I have been asked, when speaking on this subject before my assistants and students, why has not this complication been seen more frequently in medical cases which have been helpless and bedridden for many months, why principally in patients that have been operated upon? My reply has been that the ordeal, which we call operation, opens up a great many ports of entry through which microbes may reach the circulating blood current. It takes time, likely a few weeks, before the slowly recuperating system gets rid of them. Usually it is the second week after operation in which the thrombosis of the femoral vein occurs.

Besides, the effect of the general anesthesia may contribute to thrombus formation. It will be interesting to watch and observe, whether regional and local anesthesia, employed now-a-days in so many major and minor operations, will reduce its occurrence.

Weakness of the heart muscle is also to be considered in the etiology of thrombus formation.

Fortunately, femoral as well as pelvic thrombosis, as such, is rare. Yet, I am sure, every somewhat busy surgeon has met with it. And whoever has gone through the worry and annoyances it has produced, particularly in private practice, will never forget it. Very vividly stands before my memory an experience of one of the first years of my surgical practice. I had been called to operate upon a case of acute appendicitis in a private residence, and had to go ahead at midnight. The patient was the only daughter, in fact, the only child in the

family. Everything went well at first, and in the beginning of the second week, when asked again concerning the prognosis, I expressed myself as very sanguine and extended the hope that the patient would be out of bed a few days later. During the following night she complained of pain in the left groin, which increased from hour to hour, in spite of an ice-bag immediately applied. Soon the leg began to swell, and a typical femoral thrombosis developed. Not long after the femoral vein on the right side followed suit. It was more than six weeks later before I dared to allow the patient to be out of bed. The people I had to deal with were very nice; still, I sometimes felt that they blamed me for the complication.

On looking back, several cases of thrombosis re-enter my mind which occurred during the first two decades of my forty years of continuous surgical practice. I have seen it after the most aseptic surgical interferences as well as after operations for acute intra-abdominal inflammations. I have seen left femoral thrombosis set in after an operation for hernia, after the radical operation for cancer of the breast, also subsequent to operations for acute appendicitis and perityphlitic abscess, following suprapubic cystotomy, etc. Never can I forget when the father of a well-known colleague here in New York, after a suprapubic lithotomy done by me at his home, developed a left femoral phlebitis which evidently gradually extended farther up into the iliac vein. It was many weeks before the pronounced swelling of the lower extremity began to recede somewhat. A marked difference in the size of the two lower extremities persisted; he had to wear a rubber stocking that reached almost up to his hip and required special suspenders to prevent it from slipping down, a procedure which proved to be a great hardship for the patient. Barely two years later he died suddenly with symptoms of a pulmonary embolus.

On one occasion when I was visiting a semiprivate patient of mine at the hospital I saw his roommate, who had been operated upon by one of my colleagues for a stone in the kidney, drop dead upon his first attempt to walk to the window of the room. Naturally, all concerned in the case were utterly dis-

tressed. Autopsy showed an embolus riding on the bifurcation of the pulmonary artery.

I could cite other cases of the same type, as vivid in my memory as if they had occurred today. The fact that I have also seen patients with a pulmonary embolism recover under my hands might be worth mentioning, but does not fit in the realm of the present discussion.

So much is sure, and I wish to repeat it, whoever has met with this complication in practice, striking as it does so suddenly and with unexpected deadliness later on after operations, when the patient may be up and about again and ready to leave the hospital, or sick room, will never forget it.

No wonder that it has excited the interest of many medical men! No wonder that it has been thoroughly investigated and frequently discussed! I myself wrote a brief paper on the subject twenty years ago,[1] and have always tried my utmost to prevent its occurrence in my patients.

Can it be prevented? Yes. I believe it can, perhaps not absolutely, but surely reduced almost to a minimum.

It stands to reason that if we can overcome the normal anatomic impediment in the circulation of the lower extremity at Poupart's ligament and further up in the pelvis, the principal cause for the formation of a phlebitis and therewith of a thrombosis would be successfully met. This we are able to do. Just as we allow our automobile to run faster before we approach a hill right ahead of us, and then see it climb up, usually without changing the gear, in the same way we can make the blood current in the femoral veins faster, and thereby for the blood the ascent from the lower extremities to the right heart easier *if we raise the lower end of the bed*, that is to say, if we arrange for a slight degree of Trendelenburg's posture (Figs. 116, 117). Blocks placed under the foot end of the bed[2] (Fig. 118) will allow the blood within the lower limbs to run "down hill" from the toes

[1] Rare Complications After Operations for Appendicitis. Read before the New York Surgical Society, April 11, 1900, Annals of Surgery, May, 1901.

[2] At the Lemon Hill Hospital, New York, four different sizes of blocks and "steps" are in use for obtaining the posture desired for the given case.

to the hips, and in its onrush it will easily reach the veins in the upper pelvis, nay, I am sure, often the region of the renal veins, from where the negative pressure existing in the thorax, the suction of the right heart, will substitute the decreasing velocity of the blood current.

I am absolutely convinced that this simple means of raising the lower end of the bed is the most powerful weapon we possess

Fig. 116.—Slight Trendelenburg posture, with patient on his back, resting. This is the standard posture for all patients operated upon below the level of the heart; also for weak patients, operated upon head or neck, who cannot get up early.

of preventing the occurrence of femoral (and pelvic) thrombosis. I am using it after every case of operation at or below the level of the heart, in weak patients also after operations on neck and head, if they stay in bed for some time, and can truthfully say that I have not seen the typical thrombosis of the left femoral vein occur since I started doing this. In my paper on this subject, already alluded to, I mentioned that "it would be interesting indeed if experience would show that by such raising of the

lower end of the bed the occurrence of femoral thrombosis could really be prevented; that is to say, if we found that the complication occurred only in such cases where this prophylactic measure was omitted." Today I can state that this proof has been rendered.

Last year, for the first time in many years, after a cholecystectomy, I saw a patient already out of bed two weeks after operation, suddenly and unexpectedly die under the unmistak-

Fig. 117.—Same posture, with patient awake, his attention being engaged otherwise. There is no reason why the upper part of the body should not be raised on pillows at the patient's convenience.

able clinical symptoms of pulmonary embolism. She had made a smooth recovery, except for pronounced postoperative vomiting, and had been treated as usual with elevation of the lower end of the bed. Unfortunately, the family would not allow an autopsy, much as I tried to get permission for it. Therefore I cannot prove the correctness of the diagnosed cause of death. Still, the tragic suddenness of the exitus in the midst of seeming well-being and the immediate marked paleness of the face spoke

for it. The patient had had a number of children and may have harbored in her pelvic veins a thrombus for many years. She had not developed a femoral thrombosis during the after-treatment.

I would like to cite another case illustrating how a prolonged Fowler's posture can favor femoral thrombosis. As will be mentioned later on, I am in the habit of treating my patients

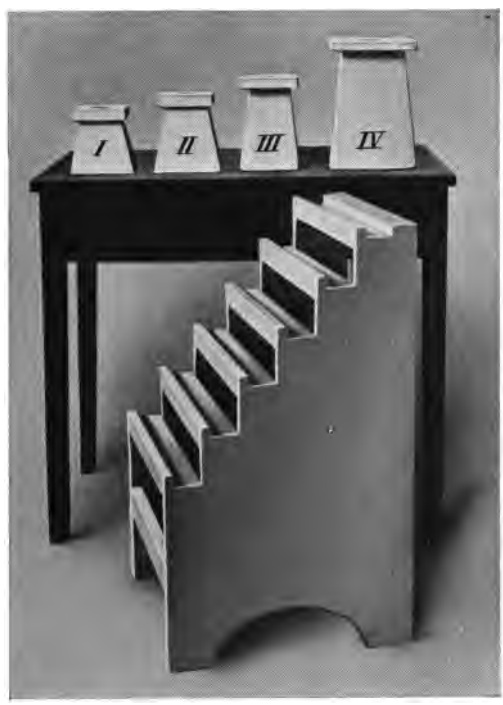

Fig. 118.—The four sizes of blocks and "the steps," as used for elevation of head or foot end of the bed at the Lenox Hill Hospital, New York. The height of the blocks is respectively 5, 6, 7, and 10 inches.

with resection of the stomach and gastro-enterostomy with a slight Fowler's posture during the first few days after operation. A lady of forty, in whom I had resected a cancer of the stomach that had developed on the basis of an old ulceration according to Billroth's operation No. 2, liked the posture very much, and begged to remain in it longer than the usually allowed three days. Just at that time I had to leave town for a few days, and

thus it occurred that she had the head end of the bed raised on blocks for ten days. At about that time she began to complain of pains in the groin and tenderness over the left femoral vein. She soon also developed some edema of the extremity. Of course, the position of the bed was quickly changed, but the annoying symptoms of the femoral thrombosis lasted longer than any other sequelæ of the operation.[1]

I would also like to mention an observation recently made in 2 patients, one after posterior gastro-enterostomy for duodenal ulcer, the other after an operation for a gangrenous appendix. In both cases a painful swelling occurred in the soft parts of the left leg, accompanied by fever and tenderness over the calf, which developed two to three weeks after the operation, and could not be diagnosed otherwise than representing a deep-seated localized phlebitis between the muscles of the calf. In both the lower end of the bed had been elevated continuously since right after the operation. Both patients got well after about two to three weeks without any further untoward symptoms.

A third case of the same type I saw recently in the practice of another colleague. He, too, got well.

The favorable preventive effect of "posture" has for many years been methodically assisted in every one of my operative patients by frequent motions, particularly of the left lower limb—I call it "bicycle riding in bed"—and by deep and frequent breathing exercises during the first one to two weeks after the operation. This latter addition I consider particularly important.

As stated already, it is possible that other factors may play a rôle in the development of venous thrombosis besides the usual horizontal posture of the patient in bed, for instance, the anesthetic. It is a fact that in some patients the expiratory air still smells of ether or anesthol on the second or even the third day after the operation. It stands to reason that the elimination of the anesthetic from the system by way of the blood in the lungs

[1] Many colleagues are inclined to order elevation of the affected extremity on pillows in such a case. Personally I do not consider such a treatment of femoral thrombosis as good or as effective as the elevation of the lower end of the bed.

will occur more quickly if we insist on regular, slow, frequent, and deep breathing exercises immediately after operation and also later on. In the first days the anesthetic will thus leave the system faster; later on, the methodic breathing, done principally under the supervision of the attending nurse, may prevent pneumonia, particularly in the old. None of us ventilate our lungs sufficiently. The reason is that we have too much lung—five lobes. The exchange of gases physiologically necessary to sustain life can well be sustained by superficial breathing. Were it not for an occasional sigh or a hearty sneeze many of us would not breathe deeply for months. Yet what a sensation of comfort and satisfaction is produced by a deep inspiration. Just think of our vacation time, gentlemen, when we stand on the deck of an ocean greyhound or float in a boat on one of the mountain lakes, how thoroughly every one enjoys the benefit of a deep inspiration! We should also enjoy it in the midst of our busy lives. Just pause and breathe deeply. There certainly will be less chance for atelectasis. By all means we all should make it a point to instruct our patients who have been operated upon to practice methodic deep breathing.

In weak patients and also after severe intra-abdominal and intrathoracic work I have added for many years to the precautionary methods, already alluded to, a prophylactic subcutaneous stimulation of the heart muscle by means of camphor, caffein, digalen, or digifolin, etc., beginning methodically immediately after the operation and continued for a number of days. Later on the same medication by mouth is resorted to.

I certainly can truthfully affirm that femoral thrombosis is unknown in my division in the hospital and also in my private practice since the strict and methodic application of the just-mentioned procedures have been practised by me during the last twenty years.

Sims' Posture, Alone, and in Combination with Fowler's and Trendelenburg's Posture.—Gentlemen, I hope not to tire you if I still talk briefly of the most beneficial effect of another posture which I have been using in postoperative treatment of my patients for many years, that of Sims (Figs. 119, 120). Of the

postures that are at our disposal, during and after operation, Sims' posture is surely one of the most useful I know of.

Personally, I believe that a case of acute gangrenous appendicitis, with its frequently present seropurulent or purulent effusion into the peritoneal cavity, fares best if the abdomen is drained with the help of Morris' cigarette drain, which carries

Fig. 119.—Typical Sims' posture, both arms of the patient pointing forward, while he rests principally on his right shoulder. His lower leg is kept straight, while the upper is flexed at hip and knee-joint, the latter touching the bed. It contributes to the patient's comfort to place a pillow crosswise between the knees.

a rubber tube in its center, or has an additional entire or lengthways split drainage-tube—I call the latter a gutter drain—attached outside. I put this drain into the lower end of the usually practised pararectal incision down to the bottom of the small pelvis and close the wound by layer sutures; I also place one or two stitches below the drain in the lower angle of the peritoneal, fascial, and skin wounds, so that after removal of

the drain, mostly in the course of the third day after operation, the buttonhole in these tissues can easily close.

I am absolutely opposed to closing up the patient's abdomen after removal of the gall-bladder. I believe the surgeon has not the right to take chances with his patient's life for the mere pleasure of seeing the abdominal wound heal by primary union throughout or for the sake of simplifying the im-

Fig. 120.—The same, with patient resting on the upper part of his chest and one arm more or less extended backward. This posture is less comfortable and is made use of exceptionally and for a short period only, should the patient get tired of the usual one. If the desirability of the lateral posture seems less pressing, he will be more satisfied, when tired, if allowed to be turned temporarily more on his back.

mediate after-treatment for the patient as well as for himself. One hundred consecutive patients with a cholecystectomy wound closed up air- and water-tight may recover smoothly; and the hundred and first may die for no other reason than that the abdomen was not drained, if the ligature on the stump of the cystic duct gave way and bile-containing microbes suddenly entered the closed peritoneal sac. I am furthermore of the opinion, so

far as cholecystectomy is concerned, that it is for the best interests of the patient if we start the removal of the gall-bladder from the fundus toward the cystic duct and not in the opposite direction. Just look at the beautiful illustrations given to the profession by Eisendrath of Chicago, exhibiting the great variety of anatomic relation between the cystic artery and the bile-ducts, also the great variety in the course of the cystic duct with regard to the common. No one can foretell whether any one of the many anomalies is present in the case just at hand. A good exposure of the junction of the cystic and hepatic ducts will show clearly the fascinating anatomic relations; it will also permit the surgeon to place the ligature close to the common duct and thus render absolutely impossible the re-formation by nature of a smaller gall-bladder after cholecystectomy, which some surgeons claim to have observed. Starting the excision of the gall-bladder from the fundus usually means more bleeding in the gall-bladder bed. It is quickly and easily controlled—best, to my mind—by an aseptic gauze tampon, which during the operation is compressed by a blunt retractor held by the second assistant, and which later on, together with the cigarette drain, that is introduced down near to the ligated cystic stump, is surrounded by a piece of rubber-dam to prevent adhesions. These three items form my way of drainage after cholecystectomy.

If, now, we place the patient in Sims' posture immediately after he has reached the bed—or, better still, when he is lifted from the operating table on the stretcher to be removed from the operating room and wheeled back to his bed—the bottom of the small pelvis after an operation for perforative appendicitis and the cystic duct-stump after cholecystectomy is the highest point of the drainage system inaugurated and not the lowest. Blood-serum, wound secretion, often also bile from the gall-bladder bed or a leaking cystic stump, will now run down hill to the outside over the shortest route possible, not uphill. I insist on the continuance of this posture for the first eighteen to twenty hours, when a slight turning of the body to the left is permitted. On the third day after the operation the patient may permanently take the usual position on the back; that

[illegible] at a time when the principal normal wound secretion has ceased. During these first few days the foot end of the bed is not raised because we all like to avoid having any wound secretions sag toward the subphrenic space from where absorption into the general circulation is favored. At the end of the third day the foot end of the bed is raised on blocks Fig. [illegible].

It is my belief that by looking ahead and always considering 'safety first' to be the solemn duty of the surgeon, the majority of the patients will do well under this treatment after cholecystectomy. The statistics of many individual men now-a-days show that of 100 patients with interval operation for appendicitis and also for acute appendicitis—the latter being done within the first twelve to eighteen hours after the onset of the attack—100 get well. Similarly we see of 100 cholecystectomies, 98 if not 99 recover. A death is usually due to an accident. I believe that drainage aided by Sims' posture, and later on by a slight Trendelenburg posture, if generally adopted, would contribute to make such results universal.

Fig. [illegible].—The same, front view. The patient is made to take this posture again for about two or three hours, when the various parts constituting drainage are removed in stages, commencing one week after operation.

I proceed in exactly the same way if, in addition to cholecystectomy, the hepatic or common duct is to be drained, or if gall-bladder and duct require drainage.

Another operation which in its immediate results is, I think, greatly benefited by Sims' posture is gastro-enterostomy. In posterior gastro-enterostomy I always join the short loop of the jenumum to the stomach in such a way that the current in both organs runs in the same direction. What is then more

Fig. 122.—Sims' and slight Fowler's posture combined during the first three days after gastro-enterostomy.

plausible immediately after a posterior gastro-enterostomy than to turn the patient into a not too exaggerated right Sims' posture and at the same time to slightly raise the head of the bed? (Fig. 122). I know from experience that the patients like this position. Although later on in the after-treatment I often repeat to them that they may well stay on the back, I find the majority of them favoring the right lateral posture. Certain it is, that I see very little if any vomiting after my gastro-enter-

ostomies. Whether or not this is partially due to the posture, I am not quite ready to decide, although I believe it is. An important contributing factor is that for years surgeons have practised the attaching of the stomach, and not of the jejunum, to the rent in the transverse mesocolon. The so-called and much dreaded "vicious circle" is no longer seen.

Remembering that a thrombosis of the left femoral vein—should it occur—makes its appearance not earlier than the

Fig. 123.—Sims' and slight Trendelenburg's posture combined, as used later on after gastro-enterostomy, the degree of lateral posture, as well as the raising of the upper part of the body being left to the patient's convenience.

second week following the operation, I never keep the head end of the bed on the blocks longer than up to the third day—at the utmost up to the fourth day—after the operation, the time peritoneal secretion ceases. The assistants and nurses know that by that time the blocks have to wander under the foot end of the bed (Fig. 123).

I insist on continuing keeping the foot end of the bed raised

until the patient gets up. As soon as he is allowed to be up and move about the blocks are removed and the normal horizontal position of the bed is resumed. I am never influenced by the requests of the patients to change these tactics. To questions of *why* I insist on the posture, I reply with the statement that I am willing to tell them when they are ready to leave the hospital. To many I have had to explain the "why" later on; others forget to ask about it again.

Only temporarily is it allowed to put the foot end of the bed down; that is, in those exceptional cases where some difficulty is experienced in urinating when the foot end of the bed is raised; often the same patients are also unable to void in the horizontal posture, but some certainly can easier relieve themselves if the bed is lowered. To allow the bladder to distend as much as possible I have always found to be a splendid policy. In my division we defer the postoperative use of the catheter as long as possible, especially with the male, without, however, being too hard on the patient. I cannot agree with those surgeons who demand catheterization if the patient has not voided within eight to ten hours after operation. Now and then we could well temporize until thirty to thirty-six hours after operation, when the patient urinated spontaneously, and then passed only 350 to 400 c.c. Why use a catheter for such a small quantity, which frequently did not bother the patient to carry in his bladder in the midst of well being! After all, catheterization, no matter how carefully and how aseptically done, means for the patient—at least for the male patient—an additional interference which if avoidable means another asset for him.

I have before mentioned Sims' posture combined with a slight Fowler's or Trendelenburg's posture. I am very much in favor of combining postures, and let the degree depend upon the amount of infection and extension of the intraperitoneal effusion. We all recognize the great service the late and much lamented John B. Murphy has done to suffering humanity with his systematic rectal instillation, the patient being in an exaggerated Fowler's posture, in cases of general septic peritonitis after intra-abdominal perforation of any sort. Special beds, very

useful ones indeed, have been constructed to make this posture comfortable and practical. Usually we can get along with a simpler arrangement. In cases of this type, if we drain at the same time, I have for years been in the habit of combining Sims' with Fowler's posture. If the lower abdomen and small pelvis was found filled with infected fluid, particularly after perforation of a gangrenous appendix or gall-bladder, a duodenal or gastric

Fig. 124.—Abdominal posture combined with Fowler's (blocks No. 4 under the head of the bed) in cases of intra-abdominal perforation of any sort with large effusion, both lumbar regions and the small pelvis being drained through intramuscular stab wounds on both sides.

ulcer, the perforation in the latter occurring shortly after a meal, we make a stab intramuscularly in both groins, introduce through it a drain into the small pelvis and the respective lumbar region, and then turn the patient right upon his abdomen, at the same time raising the head end of the bed on the highest blocks (Figs. 124, 125). I feel sure that the convalescence and recovery of some of these patients has been greatly favored by this procedure.

In this connection I must still briefly discuss the claim that the right Sims' posture employed immediately after operation, with the patient slowly recovering from the anesthetic, favors the appearance of a postoperative pneumonia, which latter complication is so often seen affecting the right lung. I do not believe in the correctness of such an assumption. During all my experience, particularly in former years, I have kept old patients after suprapubic cystotomy or prostatectomy with drainage of

Fig. 125.—The same posture, increased, the upper part of the bed raised on the steps.

bladder and prevesical space in the Sims' posture, without remembering to have seen pneumonia more readily appear in its wake. It is true the order given in these cases always has been to change the posture from right to left, or vice versa, every six to eight hours. However, it has often happened in the course of the first day that the patient desired to remain on his right side—provided this happened to be the first in which he had been placed—yet no pneumonitis was observed. On the contrary, if combined with early breathing exercises, beginning as soon as

the patient comes out of the anesthetic, I think that only benefit will accrue from the arrangement discussed.

As already mentioned, I have gone even a step further in the course of the last three years, commencing the Sims' posture *immediately after operation*, viz., while the patient is still in the operating room. In January, 1918 I did a posterior gastro-enterostomy for duodenal ulcer on a private patient. The anesthetic was given by a specialist who is rightly considered an authority in this line not only in New York and our country, but the world over. On the trip from the operating room down the elevator to the respective floor of the private building, with the patient lying on his back on the stretcher, he vomited the bloody contents of his stomach so suddenly and in such quantity and evidently, unfortunately, coinciding with an inspiration, that even the usual, most careful vigilance of the accompanying anesthetist could not prevent the partial flooding of the trachea and upper bronchial tree. It required quite some continuous careful attendance before free respiration was restored, not to speak of the anxiety endured before we knew definitely that an aspiration pneumonia would not likely set in. Later, discussing this occurrence with the colleague in question, we came to the conclusion that it would certainly be best for the patients' interest if when they were being lifted from the operating table they were placed "*immediately upon the stretcher wagon*" in the Sims' posture, this to be continued in the bed. We felt that then aspiration of the stomach contents, however small in volume, could not occur, because everything regurgitated from the stomach would, on account of gravity, have to flow to and out of the lower angle of the mouth.

The same holds true for stomach lavage, postoperatively, in cases of acute dilatation as well as persistent vomiting, or, anteoperatively, as, for instance, in retroperistalsis due to intestinal obstruction. Here Sims' posture combined with a slight Trendelenburg posture is a most valuable preventive of aspiration into the lung.

To prove the correctness of the above contention, that immediate postoperative Sims' posture arranged on the stretcher at

the time of the patient's return from the operation and then continued in bed, does not favor the development of pneumonia, but will rather prevent it, I would mention that I have been told that one of our large city hospitals has adopted this posture immediately after operation as a routine and has since observed a great reduction in the occurrence of the much-dreaded postoperative pneumonitis.

Gentlemen, I would like to continue speaking on this most interesting subject, but my time is up. I have no doubt that many surgeons, here and abroad, have observed these measures to the advantage of their patients, as I have done for a great number of years. What I wanted to bring out is, that methodic insistence on certain postures in postoperative treatment will often enable us to avoid the eventual occurrence of serious complications.

"Prophylaxis, the prevention of disease, is the highest aim of medicine."

CONTRIBUTION BY DR. CHARLES L. GIBSON

ATTENDING SURGEON, NEW YORK HOSPITAL

AND

DR. KENNETH JOHNSON

INSTRUCTOR IN SURGERY, CORNELL UNIVERSITY MEDICAL COLLEGE

PNEUMOCOCCUS PERITONITIS

PNEUMOCOCCUS peritonitis is a very interesting condition and, while not very common, presents very important problems in etiology, diagnosis, and choice of treatment.

The disease is probably more frequent than would be indicated in the literature if we include, as we must, only cases verified by bacteriologic examinations, as probably in many cases no attempt at bacteriologic examination is made, or is done so imperfectly as to be valueless. All authors speak of the difficulty of diagnosis. This view we do not share, as there are certain striking features of this condition which should put us on our guard. The 6 cases here reported on the First Surgical Division of the New York Hospital and a study of the reported cases bring out certain features.

In the typical acute cases we are dealing with young children, mostly girls.

The onset in most cases is typical of an acute peritonitis. The vomiting is irregular and not persistent. The temperature, pulse, and respiration are usually quite elevated. Physical examination shows an obvious and usually generalized abdominal distention, but the tenderness and resistance much less marked than one expects with the combination of these symptoms. The patients, while obviously acutely ill, are in pretty good condition; much more so than is seen in peritonitis from appendicitis at this stage. All show a certain characteristic hebetude;

a few minutes after disturbing the child by palpation it will go to sleep quietly. Some of these cases will show a herpes labialis. A certain duskiness is also described by many authors.

Given the above facts, one should certainly think of pneumococcus peritonitis, especially as appendicitis is not very common in young children. Typhoid fever, the other condition to be thought of, is also rare in small children, and the hyperleukocytosis of pneumococcus peritonitis contrasts with the leukopenia. It is more difficult to eliminate a pneumonia.

At operation the diagnosis should also be possible. We find a large amount of fluid with the relative mildness of the peritoneal irritation, much less than in appendical peritonitis; the color of the fluid pearly or milky white, total absence of colon bacillus smell. Then the signs of peritoneal irritation and agglutination of coils of gut are not localized. The appendix may share in the general irritation of the peritoneum, but one notices no gross structural changes.

Syms (Annals of Surgery, March, 1918[1]) reviews the subject of pneumococcus peritonitis very elaborately. Since that time a certain small experience has developed regarding the types of pneumococcus involved; otherwise, we have no findings to offer which either controvert or add to his conclusions except the question of treatment, in which we differ from his views and the majority of those who have considered this subject.

We quote verbatim the conclusions reached by Syms:

"Idiopathic peritonitis does occur.

"Pneumococcus peritonitis is a rare disease. Netter found it twice in 140 cases of peritonitis bacteriologically examined. In 104 pneumococcus infections in adults he found no case of peritonitis; in 47 such cases in children he found 1 case.

"Pneumococcus peritonitis particularly affects girls. Under fifteen years of age the proportion is 3 girls to 1 boy.

"Pneumococcus peritonitis may occur: First, as a single lesion, *i. e.*, alone; second, as a sequel to some other site of infection, as the lung, pleura, etc.; third, it may be followed by invasion of other localities, lung, pleura, etc.; fourth, it may be a

[1] This article contains twenty references in the literature.

local manifestation of a general septicemia. Probably it is always that.

"Pneumococcus peritonitis is found in two forms: First, the diffuse; second, the encysted. These forms may represent different types or varieties of the disease or they may represent different stages of the disease. This is yet to be demonstrated.

"When the peritonitis is encysted the prognosis is good, spontaneous recovery may take place in one of several ways. Operation results in a high percentage of recoveries (86 per cent.).

"When the peritonitis is diffuse the prognosis is bad—death is the rule. Operation results in very high mortality (86 per cent.; in some series 100 per cent.).

"We recognize a symptom syndrome which should make diagnosis reasonably certain in typical cases.

"Operation should not be performed in the diffuse form.

"Operation should always be performed in the encysted form.

"The above represents the sum total of our present-day knowledge of this subject as set forth in the literature to date.

"While I have nothing new to add to this subject, I feel that I may be performing a service by propounding certain questions which have not yet been answered. The satisfactory solution to some of these questions would go a long way toward improving our treatment of this disease.

CERTAIN POINTS OF INTEREST AND IMPORTANCE WHICH ARE YET TO BE CLEARED

"1. Why is the disease most common among children?

2. Why is the disease more common among girls than among boys?

3. How does the disease invade the peritoneum?

4. Is there a local port of entry?

5. Is there always septicemia?

6. Will the blood always show pneumococcus? If not, in what per cent.?

7. Is the secondary form caused by blood infection?

8. Why is diarrhea so frequently a symptom?

9. Is there commonly an enteritis?

10. Do the diffuse and encysted forms represent types of the disease, or do they represent stages?

11. If they are two different types of the disease, are they caused by different types or strains of pneumococcus?

12. Have pneumococci been classified in this and in other lesions, as they have been classified in pneumonias?

13. What can we hope from serum treatment in this disease?

14. Are the chlorids diminished in pneumococcus peritonitis as they are in pneumonia?

15. Will the administration of chlorids show the same benefit they have shown in the treatment of pneumonia?

"Before closing, I will touch briefly upon some of these questions. The first four are really of academic interest, and will undoubtedly be answered more or less completely as time goes on.

"5, 6, and 7 may be covered by one answer. There is undoubtedly always a bacteremia; the peritonitis is really a local manifestation of a systemic infection. When peritonitis is secondary to some other lesion, as pneumonia for instance, the disease doubtless reaches the peritoneum through the blood-stream. Undoubtedly the blood should always show the presence of pneumococci. I cannot do better than to again quote the words of my friend, Doctor James G. Dwyer, to whom I put this question:

" 'The disease probably gains access to the peritoneum through the blood. It is probably always a bacteremia, the organisms circulating through the blood and localizing in the peritoneum. Blood-cultures if taken often enough, at the proper time and sufficient blood drawn, would be a valuable method of diagnosis on this point. A negative blood finding would have no meaning, as the mechanical and bacteriologic reasons of why we get negative blood-cultures when we should get positive hold good here. Blood-cultures should show a bacteremia.'

"10, 11, and 12 may similarly be expressed in one answer. Thus far the pneumococcus in its relation to peritonitis has not been systematically studied as it has in its relation to pneumonia, though some investigation along this line was made by Michaut many years ago.

"Whether the diffuse peritonitis cases with extreme toxemia represent a distinct type and are caused by a strain of pneumococcus of extreme virulence (Group III) remains to be proved. It is a matter of the greatest importance and should receive the fullest possible investigation. For this purpose, bacteriologically, our peritonitis cases should be subjected to the most intensive study.

"Serum therapy should have the same place here as it has in the treatment of pneumonia.

"The questions as to the chlorids yet remain to be investigated and answered."

Etiology.—The etiology of this condition and the portal of entry of pneumococcus remain an unsolved problem. We can offer no views of our own. One is tempted to think that in some patients the peritonitis is postpneumonic, the original condition having been mild or having pretty well cleared up when the patient comes under observation. Naturally, the frequency in girls suggests the pelvic viscera. Why the disease affects chiefly young children we have no good explanation.

Symptoms.—The duration of symptoms before coming to operation is variable. Usually the onset is not very acute and the progress not very rapid. The symptoms are mostly abdominal, pulmonary being either absent or mild. These are not incompatible with mild pneumonias in children.

Vomiting is generally noted, but not so typically as is usual in progressive peritonitis. Diarrhea is mentioned about as often as constipation. Torpor or hebetude of some degree, the manifestation of an intoxication, is a constant sign and the patient presents a picture of general malaise. Chills are exceptional as they are in the pneumonias of children.

Abdominal pain is a constant manifestation and begins early. It tends to be constant and progressive. It is earliest referred to the lower abdomen rather than the upper. With the progress of the disease it is referred to the whole abdomen. On physical examination we note distention of the abdomen with tenderness to palpation and rigidity of the muscles, but the tenderness and resistance do not seem to be marked as one

should expect in relation to the other symptoms, particularly the distention and the elevation of pulse and temperature.

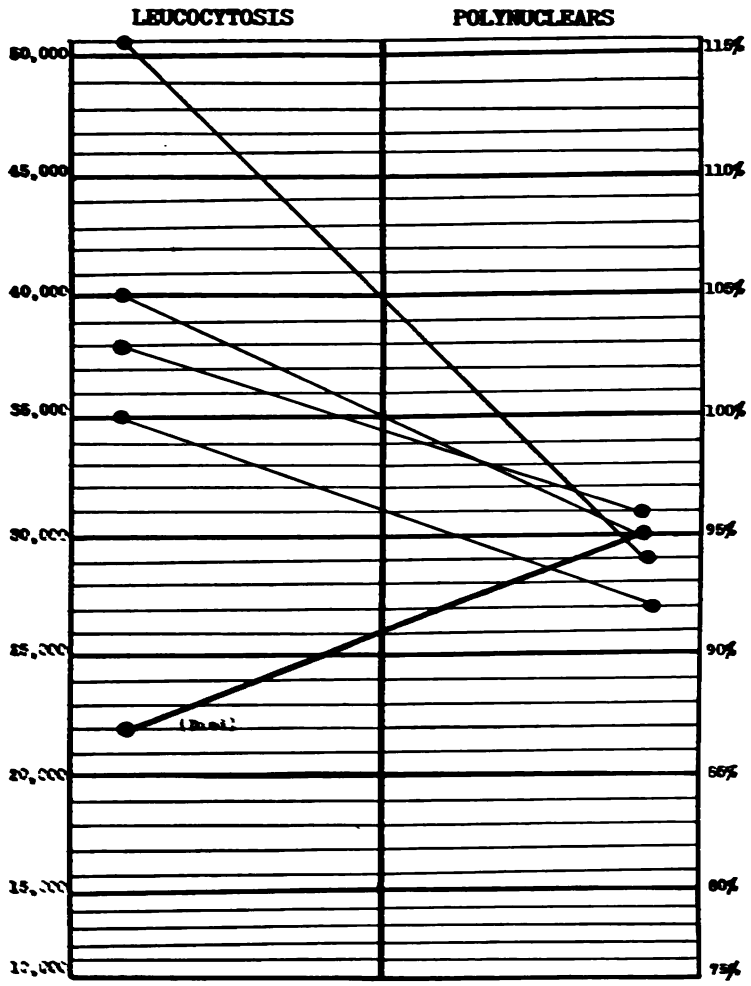

Fig. 120.—Differential count in 5 cases of pneumococcus peritonitis.

Pulse and temperature run high and are typical of an acute peritonitis.

Blood examination (Fig. 120) is a tabulation of the differential counts made before operation in 5 of our cases. They

are computed on the Standard Chart described by Gibson in the Annals of Surgery, April, 1906. According to the views then formulated the direction of the line joining the two records —total leukocytosis on one side, percentage of polynuclears on the other—has some bearing on the body resistance to infection.

Spreading infections and infections that meet little resistance should give a rising line; localized or well-borne infections, a line which tends to the horizontal or points downward. The accompanying table shows two interesting features—the unusually high leukocytosis seen in the bulk of these pneumococcus peritonitis cases and the sharply descending line in all but the one fatal case.

Examination of the blood by culture is variable. We have no data regarding the early appearance of the bacteria and only imperfect data as regards its disappearance in the cases remaining under observation. When both the blood-culture and the culture from the peritoneal fluid have given definite results as regards grouping under the four types of pneumococci they have agreed. While in all our cases we have obtained a culture of the peritoneal fluid, we have only data on the blood-cultures in Cases III, IV, V, and VI. Cases IV and V sterile. Cases III and VI showed pneumococcus.

Clinical Types of Pneumococcus Peritonitis.—Most authorities speak of a localized type and a generalized type, and usually conclude that the localized type is the end-result of a generalized type. Some cases in the literature have been reported of operations consisting in the evacuation of a well-defined localized abscess rather than an actual peritonitis. Most authorities recommend giving the generalized type expectant treatment in the belief that operation at this stage is usually futile or attended with very bad results, and it is better to wait for the manifestations of a more localized type. To this view we cannot give our assent.

Treatment.—Shall we operate? If so, when and how? Obviously, the thought occurs that if the pneumococcus peritonitis represents a localization of a general process, there should be a reasonable probability of the condition getting well spon-

taneously with the subsidence of the general infection. The time has not yet come, we think, when we dare wait on these acute cases, for we think it would be most unwise, with the present limitations of diagnosis, to take the chance of letting a peritonitis from an appendix (or other condition) slip through our hands. Even if we could make a diagnosis from a blood-culture some forty-eight hours would have elapsed. Possibly more rapid methods of certain diagnosis may be developed in the future.

As stated above and for the reasons outlined, we differ from other writers who warn against operating in the diffuse form. The opponents of immediate operation have based their views on the great mortality said to attend early operation (Annand and Bowen give 86 per cent. mortality), but our personal experience has been favorable—16 per cent. mortality.

If an operation is performed in the acute stage a fairly thorough exploration should be made, the appendix always seen, and it would be wise to take it out, as it may possibly be the source of trouble. The preponderance of opinion has been in favor of drainage. The opening in the abdominal wall can be closed for the most part. The only fatal case in our series was not drained. In this case the amount of fluid was quite small and the peritoneal irritation slight.

Specific therapy, certainly in theory, is desirable, and although the case for specific therapy is not quite settled, we think all will agree with us that it is desirable to isolate promptly the particular type of pneumococcus and administer the corresponding serum. The reports of types isolated have been largely of Groups I and II, Group I predominating. The question comes whether we should wait the necessary time for the differentiation or rather begin the administration of the most frequent, Group I; or is it better to begin with the so-called polyvalent serum. The whole subject is very important, and it is hoped that publication of this paper may stimulate the study of the question. We are emphatically against resorting to the specific therapy as against operation, as we still believe that the best judgment calls for operation.

Summary.—Pneumococcus peritonitis is an acute infection occurring in children, and particularly girls.

The relationship of its incidence to a pre-existing pneumonia is not established, but probable in a small proportion of cases.

Patients show the usual signs and symptoms of an acute and extensive peritonitis, but do not seem as sick as usual and the tenderness and rigidity are also less marked. There is a drowsiness or torpor which is constant. Herpes labialis is seen frequently and is believed to be a valuable diagnostic sign.

Operative findings are typical—large amount of free milky fluid, absolutely odorless. There are no focal manifestations. The peritoneal reaction is less marked than customary with so much exudate.

Treatment recommended is operation at any stage, with pneumococcus serum during the convalescence. Type I serum given until the exudate and blood-cultures demonstrate the presence of one of the other strains.

Operation will consist in median laparotomy, with exploration of other focal sources of peritonitis. The fluid should be completely evacuated by suction and a temporary rubber drainage-tube led into the pelvis. Closure of the wound and usual after-treatment, particularly Fowler's position.

It is our belief, supported by our own experience, that the mortality should not be high, contrary to the generally expressed belief of other authors.

Case I.—Lilly L. Age seven. Admitted June 9, 1913. Discharged July 16, 1913.

Chief Complaint.—Pain in lower abdomen.

Present History.—Yesterday vomited several times and had frequent watery stools. At 3 A. M. today had a sudden severe pain in the epigastrium. It was colicky in nature and later became more localized to the right lower quadrant. Vomited several times during the day and had a marked diarrhea. (No mention made of chill in old history.)

Past and Family History.—No bearing on case.

Physical Examination.—Well developed. Acutely ill.

Head: Tongue badly coated. Mucous membrane of mouth dry.

Thorax: Expansion good and equal.

Lungs: Resonance good. Breath sounds clear everywhere.

Heart: Sounds of good force. Regular. No murmurs.

Abdomen: Distended. Tympanitic. Tender everywhere. More marked in right lower quadrant. Some muscle spasm.

Operation.—Appendectomy for acute appendicitis. Appendix slightly congested. A small amount of fluid of a serum nature free in abdominal cavity.

Course.—Operated upon on day of entry. Eight days later as condition was same—temperature high, pain present in abdomen, and no signs of improvement—patient was transferred to medical side. Wound was clean. No redness or distinct tenderness along incision line. Entire abdomen distended and tender. Stools foul and loose. Was diagnosed here as pneumococcus peritonitis. Wound broke down and pus evacuated. Pelvic abscess formed. Was opened June 25th, and a culture showed it to be a pneumococcus peritonitis. It was not felt that the original condition was the same.

Clinical Pathologic Findings.—Laboratory report of appendix: Acute catarrhal appendicitis.

Bacteriologic report: Culture of pelvic abscess—pneumococcus.

Blood count: On entry, W. B. C., 51,500. Polys., 94 per cent.

Four days later W. B. C., 15,000. Polys., 82 per cent.

Respiration: High, 30–36.

Pulse: High, 112–160.

Temperature: Irregular—from 101° to 104° F. Did not come down for over a month.

Case II.—R. S. Age nine. Admitted April 19, 1915. Discharged May 25, 1915.

Chief Complaint.—Three days ago was suddenly taken sick with cramplike pains in epigastrium. A few hours later she vomited three times at intervals and had a severe chill. The pain persisted for next two days and became more severe. It

extended over the whole abdomen and was associated with tenderness, especially on the right side. No headache and no cough. Frequent greenish stools.

Past History.—No bearing on case.

Physical Examination.—Well developed and well nourished. Appears drowsy and acutely ill.

Head: Face flushed. Nose normal; alæ nasæ move with respiration. Mouth: marked bilateral herpes labiales. Tongue very furred.

Neck: Tenderness on both sides along line of carotids. Bilateral enlargement of submaxillary nodes.

Chest: Expansion limited and rapid. Respirations 30 to 36.

Lungs: Normal percussion and breath sounds. Patient seems unable to draw a deep breath and breathes with upper part of lungs. Dr. Conner found absolutely no lung condition to warrant diagnosis of pneumonia.

Heart: Second pulmonic accentuated. Pulse about 100.

Abdomen: Walls rigid over the entire abdomen. Marked tenderness over entire abdomen. Does not appear to be localized.

Clinical Pathologic Findings.—Urine: Negative.

Blood count: On day of admission, W. B. C., 40,000 } 300
Polys., 95 per cent. } counted.

Nine days after admission, W. B. C., 31,000
Polys., 88.5 per cent.

Seventeen days after admission, W. B. C., 24,000 } 200
Polys., 86 per cent. } counted.

Twenty-two days after admission, W. B. C., 11,200
Polys., 81 per cent.

Operation (April 19, 1915).—For acute appendicitis with diffuse peritonitis; 3-inch oblique McBurney incision. Large amount of thin yellow pus found in abdominal cavity. Appendix was swollen, red, and covered with fibrinous exudate. Drain inserted. Discharged for two and a half weeks.

Laboratory Report of Appendix.—Chronic catarrhal appendicitis with acute inflammation of peritoneal surface.

Bacteriologic Report.—Organism isolated from material in abdominal cavity was undoubtedly the pneumococcus.

Five days after admission cough developed. Lasted a week. There were a few scattered râles at the time. Breathing slightly changed. Respiration rapid, 30 to 36. Pulse 140 at first. Gradually came down to about 100 in five weeks. Temperature:

First week, 101.3° F.; operated, ranged from 100° to 103° F.

Second week, 100° to 102° F.

Third week, 103° F.

Fourth week, around 99° to 101° F. Touched normal once.

Fifth week, around 99° F.

Case III.—M. F. Age six. Admitted April 29, 1915. Discharged June 10, 1915.

Chief Complaint.—Pain over lower abdomen.

Present History.—Yesterday was suddenly taken sick with cramplike pains in the abdomen (not localized). Ate a hearty meal, which was retained, and patient felt better; but four or five hours later pain came on again. There was nausea, vomiting, and increase of colicky pain. Could not eat and was kept awake all night by sharp, stabbing, cramplike pains. Headache persistant. Bowels constipated.

Past History.—No bearing on case.

Physical Examination.—Well-developed child. Is acutely ill.

Head: Tongue much coated. Tonsils slightly enlarged. Alæ of nose did not move in respiration. Herpes around lips not marked.

Thorax: Fremitus, percussion, voice and breath sounds normal throughout. No râles. Four days after admission there were a few crepitant râles in right lower lobe posteriorly. No change in breath and voice sounds or on percussion.

Heart: Rapid—130. Otherwise O. K.

Abdomen: Rigidity over entire abdomen, and generalized tenderness. The slightest pressure anywhere caused great discomfort. Especially marked on right lower side.

Clinical Pathologic Findings.—Urine: 1019, alk., amb. Tr. alb., no glucose. Many hyaline and granular casts.

Blood: On admission, W. B. C., 38,000. Polys., 96 per cent.

Four days after admission, W. B. C., 14,000. Polys., 79 per cent.

Nineteen days after admission, W. B. C., 16,600. Polys., 74.5 per cent.

Operation (April 29, 1915).—For acute appendicitis. McBurney incision. Considerable thin, light, non-odorous fluid in peritoneal cavity. Appendix was swollen, red, and covered with fibrinous plaques. Removed. Culture taken. Drain inserted. (Drain removed in eight days.)

Laboratory Report of Appendix.—Acute catarrhal appendicitis with acute peritonitis.

Bacteriologic Report.—Organism isolated showed to be pneumococcus.

Blood Culture Report (April 29th).—Organism isolated from this culture when grown on human blood-agar shows colonies resembling the pneumococci. Inulin fermented in twenty-four hours. Diagnosis: Pneumococcus.

Four days after admission cough developed and lasted for six days. At this time râles in right lower lobe posteriorly. Respiration high, 30 to 45 per minute. Pulse rapid, 110 to 150 per minute.

Temperature.—First week, 105° F.; after operation dropped to 102° F. in twenty-four hours; 102° to 104° F. for week.

Second week, irregular. Normal to 102.5° F.

Third week, irregular. Big variations from normal to 103° F.

Fourth week, around 101° F.

Case IV.—M. C. Age forty-one. Married. Admitted October 17, 1919. Discharged November 19, 1919.

Chief Complaint.—Pain in upper abdomen.

Present History.—Started three days ago with sudden cramp-like pain in upper abdomen. Next day whole abdomen felt sore and pain of jumping character returned that night, and has continued intermittently ever since. Pain and soreness much worse today than previously. Yesterday took castor oil, but bowels moved but little, and today patient was given an enema. Has always been constipated. Nauseated and vomited past two days.

Past History.—Has not felt well since coming to America seven weeks ago. Has had frequent headaches, but no definite stomach trouble.

Examination.—Middle-aged obese woman, acutely ill. Everything negative except abdomen, which was of boardlike rigidity and distended throughout. Marked tenderness in right upper quadrant just above umbilicus. Slight tenderness over remainder of abdomen. No masses.

Clinical Pathologic Findings.—Blood count: October 17, 1919, W. B. C., 35, 900. Polys., 92 per cent. Lymphos., 8 per cent.

November 2d, W. B. C., 21,600. Polys., 85 per cent. Trans., 3 per cent. Lymphos., 8 per cent. L. mino., 4 per cent.

November 4th, W. B. C., 20,000. Polys., 78 per cent. Lymphos., 22 per cent.

Urinalysis (October 19, 1919): Specific gravity 1024. Reaction alkaline. Color red brown. Microscopic oxalite R. B. C. Acetone and diacetic. No albumin or glucose.

Operation (October 17, 1919).—Peritoneum contained a large amount of turbid serum and flakes of fibrin. Bowel enormously distended, especially cecum. Appendix subcecal, atrophic at its base, swollen, very dark, if not necrotic, at the tip, with some fibrin on it. Exploration of rest of abdomen negative except for a large amount of purulent fluid in the pelvis and a very much enlarged uterus, about 6 x 4 inches, and very hard, but no apparent disease of the appendages. Rubber tube and cigarette drain to the pelvis. Partial closure. Note: Diagnosis of appendicitis is probable, but not definitely established.

Laboratory Report of Appendix.—Acute appendix. The peritoneal surface is the seat of an acute exudative inflammation.

Bacteriologic Report.—Culture from peritonitis shows growth of pneumococcus, Group II.

Blood-culture sterile.

Temperature.—On admission 103° F. Pulse 120. Respiration 32. Eight o'clock temperature day following operation 103.8° F. Then dropped until at end of first week temperature was between 100° to 101° F.

Second week varied between normal and 101° F.

Third week varied between normal and 101.6° F.

Fourth week varied between normal and 100° F.

No pulmonary signs at any time.

Case V.—Sarah G. Age five. Admitted March 29, 1920. Discharged July 7, 1920.

Chief Complaint.—Pain in abdomen, fever, vomiting for past week.

Present History.—Began two weeks ago with cold, cough, and running at nose. Fever has been intermittent. Some days temperature has been 104.2° F. Complains of pain across abdomen. Bowels do not move without enemata. Vomited last week. Mother thinks temperature is higher at night than in the morning.

Past History.—No bearing on case.

Physical Examination.—Young child lying quietly in bed, looks acutely ill, cheeks flushed, breathing slightly accelerated. No cyanosis.

Lungs: Percussion note resonant throughout. Breath sounds vesicular. Few sticky râles anteriorly over large tubes on both sides. No areas of consolidation or bronchial breathing. Pulse good quality, although rapid.

Abdomen: Well nourished, of good conformation. Rigidity over entire abdomen. Tenderness especially localized in area below umbilicus. Owing to rigidity no deep palpation was possible. Dr. Roper felt a mass to right of midline in pelvis by rectal examination.

Clinical Findings.—Urinalysis: Negative. Blood counts: April 1, 1920, W. B. C., 7000. Polys., 55 per cent.

April 2, 1920, W. B. C., 12,000. Polys., 45 per cent. Lymphos., 55 per cent., 200 cells counted.

April 3, 1920, W. B. C., 10,500. Polys., 66 per cent. Lymphos., 34 per cent., 200 cells counted.

Wassermann negative.

Operation (March 30, 1920).—Coils of small intestine and omentum were matted together in the pelvis. Wound was enlarged downward, and on attempting to separate the adherent coils of intestines numerous abscess cavities were opened into.

The pus had no odor, was thick and creamy in character, with a slight greenish tinge, and contained large particles of fibrin. Culture was made from the pus and from one of the pieces of fibrin. All the abscess cavities were between the coils of the small intestine and were chiefly confined to the lower half of the abdomen and especially to the pelvis. All these coils were separated and the abscesses thoroughly opened. The appendix was found lying over the pelvic brim, slightly swollen, but apparently involved from without. Appendix removed. Base ligated. Right fallopian tube was markedly swollen in its peripheral half, but no pus could be milked from it. The origin of the abscess could not be definitely determined. Rubber-dam Mikulicz tampon with two pieces of 4-inch iodoform gauze was then placed in the pelvis, completely blocking off the gut from the abscess cavity. (Localized case.)

Laboratory Report of Appendix.—Subacute periappendicitis. On the peritoneal surface there is a considerable quantity of granulation tissue, infiltrated with polynuclear cells. The wall of the appendix itself is uninvolved.

Bacteriologic Report.—Culture from appendix shows a pure growth of Diplococcus pneumoniæ, Type I.

Blood-culture sterile.

Temperature.—On admission 102.8° F. Respiration 40. Pulse 140.

Discharge Note: Culture of pus in peritoneal cavity reported Group I pneumococcus. Blood-cultures taken on four successive days after operation reported sterile. Convalescence prolonged and stormy. Fecal fistula developed on eighth postoperative day with considerable febrile reaction. Temperature curve thereafter very irregular. Discharged on one hundredth postoperative day with wound practically closed. (Ward in quarantine for last two weeks of child's convalescence.)

Case VI.—Fannie G. (sister of Sarah G., Case V). Age four. Admitted October 31, 1920. Died November 1, 1920.

Chief Complaint.—Pain in abdomen.

Present History.—Two days before admission had pain in abdomen, apparently general. Vomited two or three times after

the onset of the pain, vomitus consisting of food taken before. Taking of water seemed to cause vomiting. On day before admission continued to have vomiting. On admission patient has localized pain. Greatest point of tenderness directly above and below umbilicus. Temperature day before and day of admission. No chills. Bowels have moved every day. Enema on day before admission gave no relief.

Past History.—No similar attacks previously. During week before onset of present illness patient had cough. No expectorations and no pulmonary symptoms.

Physical Examination.—Looks feverish, but not acutely ill. Very drowsy. Well nourished. Lungs: Negative for signs of pneumonia. Abdomen: No distention. Some rigidity in lower half. Pain on palpation localized around umbilicus. No masses felt. No organs palpated. Herpes on lower lip.

Clinical Pathologic Findings.—Urinalysis negative.

Blood count: October 31, 1920: W. B. C., 22,200. Polys., 95 per cent. Lymphos., 5 per cent.

Operation (October 31, 1921).—Peritoneum seems a little injected and intestines slightly distended. On pushing up omentum about ½ pint of turbid fluid evacuated. This fluid is rather less milky in appearance than found in such cases. Is perfectly odorless. No lesion. Appendix is somewhat irregular in character and deemed best to remove it. No drainage.

Bacteriologic Report.—Culture of pus from peritoneum shows pure growth of pneumococcus Type I (mouse method).

Culture of blood in plain and dextrose broth shows pure growth of pneumococcus, Type I.

Temperature.—On admission 104.8° F. Pulse 140. Respiration 40.

Discharge Note.—Cultures of blood and of pus from abdominal cavity showed pure growth of pneumococcus, Group I. Lungs negative, though history of recent cough was obtained. Continued to be semicomatose and died twenty-four hours after operation.

Received one dose of polyvalent serum.

CLINIC OF DR. EUGENE H. POOL

NEW YORK HOSPITAL

OPERATION FOR THE REMOVAL OF COMPLETE CERVICAL RIB

OPERATION for the removal of a cervical rib often proves difficult and the result unsatisfactory. Two cases of complete cervical rib are presented; in the first there was incomplete

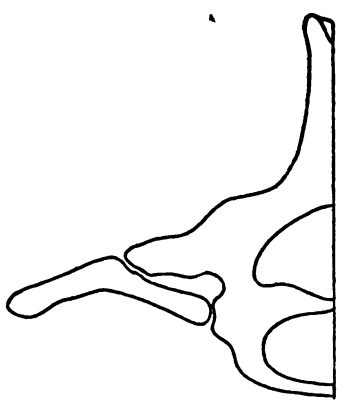

Fig. 127.—Rudimentary cervical rib. (From Ergebnisse.)

removal; in the second the rib was adequately removed by a procedure to which I wish to call attention. But before describing the operation certain features which are of practical importance will be reviewed.

Streissler[1] has presented an exhaustive discussion of the subject. The illustrations reproduced from his article give sufficiently in detail the anatomic relationships of both complete and partial cervical ribs (Figs. 127–131).

[1] Ergebnisse der Chirurgie und Orthopädie, Band v, 1913, 281 (bibliography).

Many people are not inconvenienced in anyway by the presence of such ribs. Others present quite definite symptoms which are dependent upon pressure on the brachial plexus and the axillary vessels, and consist in disturbances of sensation, edema, and local temperature changes. The two cases here presented illustrate quite typically the symptoms which call for operative intervention. Palpation in the supraclavicular region

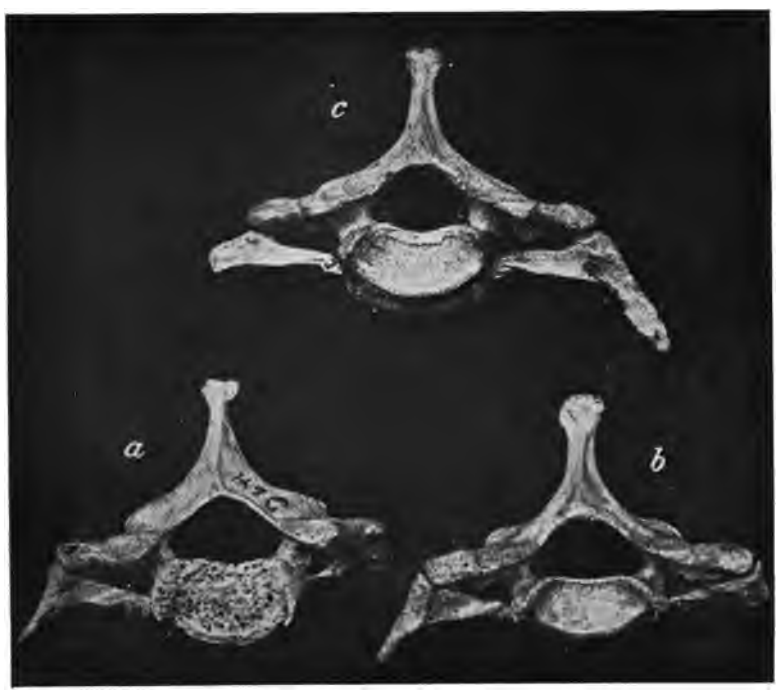

Fig. 128.—Rudimentary cervical ribs. (From Ergebnisse.)

reveals a bony swelling. The presence of the anomalous rib is readily demonstrated by *x*-ray examination.

A peculiar feature is that the symptoms frequently begin after some trivial accident, as a fall upon the outstretched hand. Young women are often affected. The patients frequently are the type which suggests hysteria. Yet a real anatomic basis to explain the subjective symptoms, striking objective signs, and

the fact that a cervical rib or other anomaly was not suspected by the patient before the onset of symptoms preclude an exclusive psychic basis. Moreover, the symptoms and objective signs usually cease after correction of the anomaly.

Operation is advisable when symptoms develop which are sufficiently severe to incapacitate the patient or to cause persistent suffering or annoyance. To ensure a permanent cure

Fig. 129.—Bilateral cervical ribs. (From Ergebnisse.)

Streissler claims that the rib should be removed back to the vertebra and its periosteum should also be removed; otherwise regrowth of bone may occur and cause recurrence of pressure symptoms.

Both anterior and posterior approaches have been recommended. In our first case the anterior method was employed, and the rib was, of necessity, incompletely removed. Although

a cure was affected, which may be regarded as permanent, since six years have elapsed since the operation, we have felt that insufficient rib is removed by this method to justify confidence that a cure can be relied upon. In the second case a combination of anterior and posterior methods worked out admirably. The method appears to have features to commend it, especially the fact that the rib is adquately removed. Apparently the

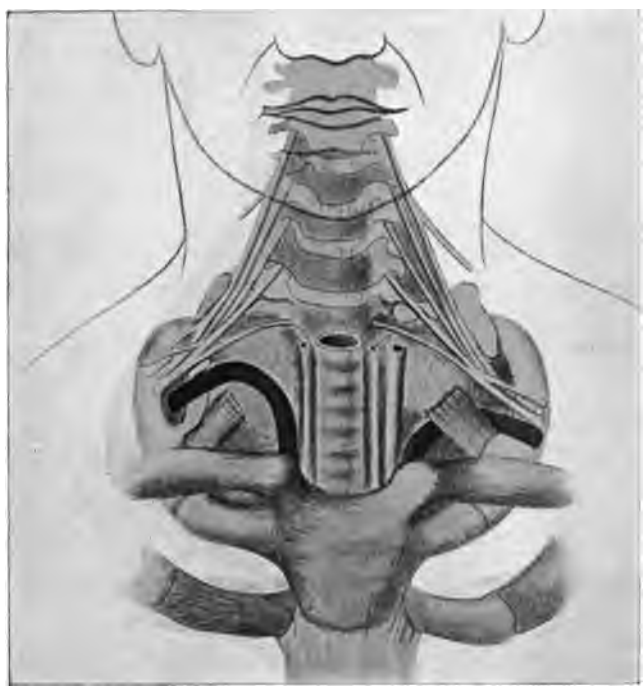

Fig. 130.—Incomplete bilateral cervical ribs. (From Ergebnisse.)

chief disadvantage is the possibility of injury to the spinal accessory nerve, but the nerve should be avoided if its situation is borne in mind and the incision through the trapezius is made rather above and behind its course.

Case I.—L. M., female, age nineteen; operator; single. Admitted to the New York Hospital July 22d; discharged July 31, 1914. Chief complaint was pain and tingling in right

hand. Six months before admission patient experienced pain and tingling in right hand. Right arm felt numb. The pain and tingling persisted. Patient said that in August, 1913 she fell on the palm of her right hand; she did not remember any other injury. No member of her family had a similar complaint. The patient was a healthy looking girl. There was slight fulness in right supraclavicular fossa. This fulness was

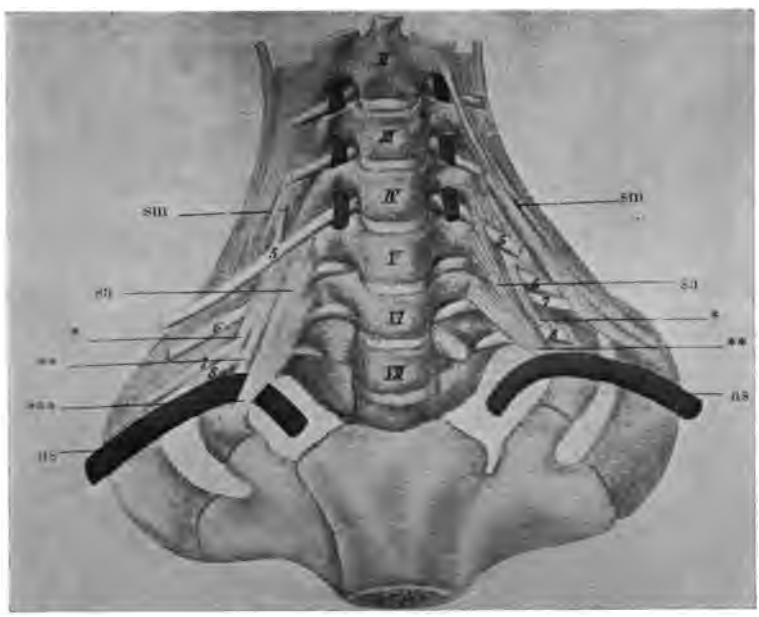

Fig. 131.—Complete bilateral cervical ribs, showing artery and plexus passing over the rib; also attachments of M. scaleni. (From Corning.)

evidently bone. The right hand was slightly colder than the left. Right radial pulse barely perceptible, left easily felt. No difference in sensation or power on the two sides. Knee-jerks present. *x*-Ray showed bilateral cervical ribs (Figs. 132, 133).

Operation, July 24th: Collar incision 3 inches long; 1 inch above right clavicle. Dissection exposed rib between brachial plexus, which was drawn gently backward, and artery, which was drawn forward with retractors. The anterior portion from

beneath plexus to sternum was freed. It was then freed posterior to plexus and rib was cut across as far back as possible. But this was only a short distance posterior to plexus. Its anterior attachment to first rib was divided and the detached portion of the rib, including periosteum, was removed. On discharge wound healed. Pain had almost disappeared.

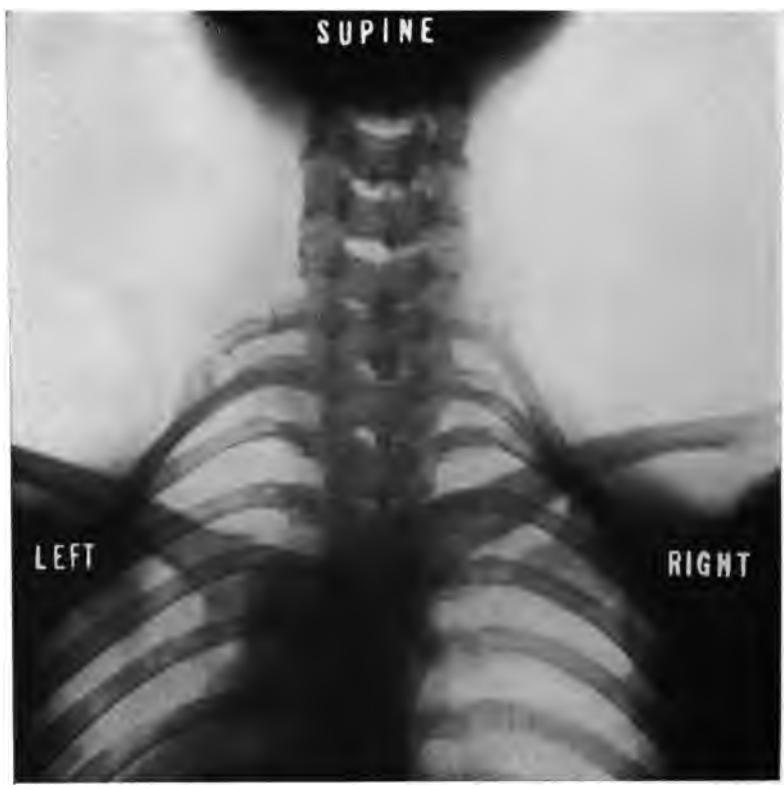

Fig. 132.—Case I. Before operation.

Late result: Patient has experienced nothing abnormal except that her right hand tires more readily than the left; yet she thinks the strength of the two hands is about equal. There has been no numbness or pain. On April 16, 1920 the right pulse is still much weaker than the left. Strength of two hands about

the same. Reflexes equal. Apparently slight decrease in superficial sensibility over entire right hand and forearm.

Measurements: *Right*, arm, 29 cm.; forearm, 24.5 cm. *Left*, arm, 30.5 cm.; forearm, 25.5 cm.

Case II.—A. S., female, age seventeen; single; stenographer; admitted to the New York Hospital April 19, 1920; discharged

Fig. 133.—Case I. After operation.

May 1st. Chief complaints were weakness of left arm; transitory swelling of left hand; irregular pains and numbness in left arm.

Two months before admission patient noticed that while reading she could not hold a book in her left hand as long as in her right. Soon she found that she could not use her left hand

Fig. 134.—Case II. Before operation.

Fig. 135.—Case II. Postoperative.

for typewriting as efficiently as her right. She then noticed that her left hand began to swell occasionally, but only remained

swollen for a few hours. She sometimes noticed it in the afternoon, but by the next morning the swelling was gone. Her hand became slightly blue when the swelling was present. About the same time she began to have dull, irregular pains in the left arm. Sometimes these began at the elbow and radiated to the wrist, sometimes they were confined to the axilla, and once pain was felt at the wrist only. Nothing that she did relieved the pain (Figs. 134, 135).

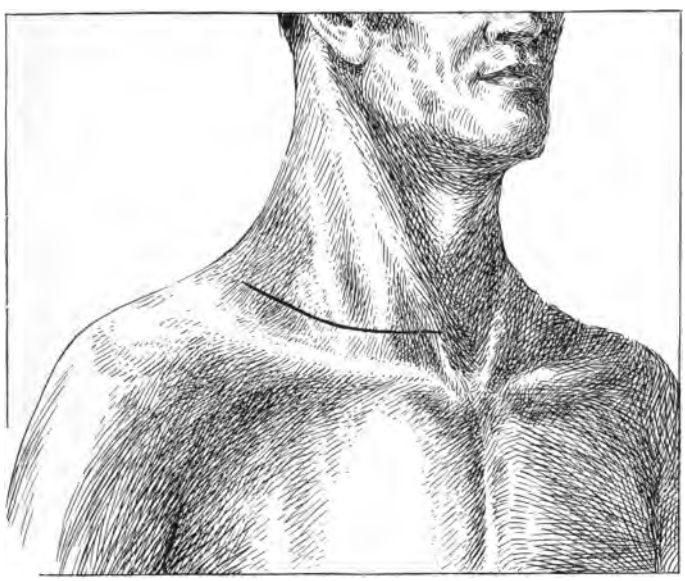

Fig. 136.—Line of incision for removal of cervical rib.

At the same time that she noticed the pain and weakness she noticed that her arm felt numb. This persisted for only a few days. Her left hand at intervals felt colder than the right. Her general health was always excellent.

Previous personal and family history negative.

Physical examination on admission: Well-nourished and well-developed girl. Nothing abnormal was found other than the surgical condition. There was a definite bony resistance in both supraclavicular fossæ. On the left side there was marked

tenderness. Both arms equal in size and apparently in strength. The left arm everywhere sensitive to touch and perception of heat and cold. No visible trophic changes in the skin. No points of tenderness. *x*-Ray showed bilateral cervical ribs.

Operation: Collar incision beginning ½ inch above sternal end of left clavicle (Fig. 136). Platysma and deep fascia cut, exter-

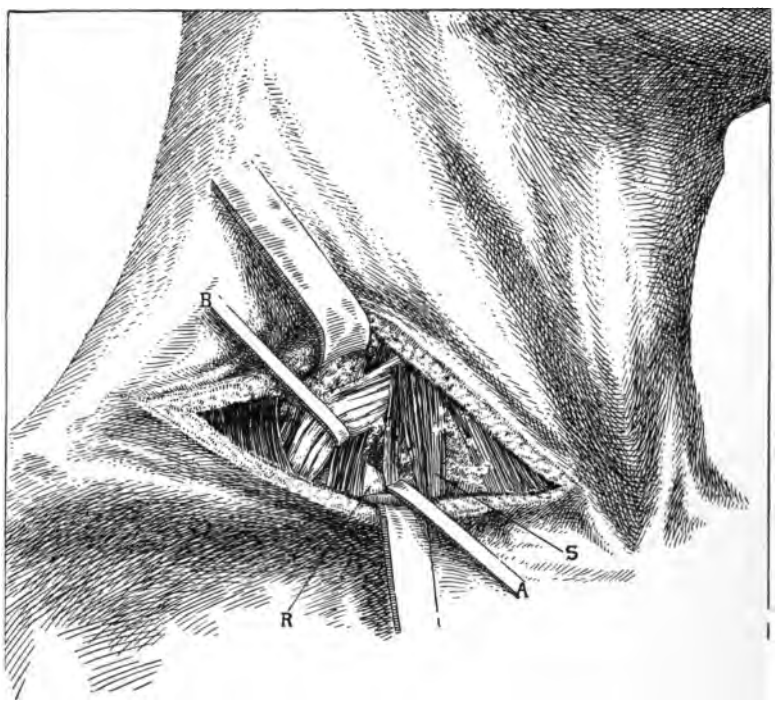

Fig. 137.—Operation for removal of cervical rib: *R*, Cervical rib; *A*, retractor drawing axillary artery forward; *B*, retractor drawing plexus up and backward; *S*, scalenus anticus.

nal jugular being ligated and divided. Posterior edge of sternomastoid drawn mesially; anterior edge of trapezius incised slightly and retracted for better exposure. Plexus easily defined by blunt dissection. The subclavian artery was readily recognized anterior to the plexus. The plexus was then gently retracted posteriorly and the artery anteriorly (Fig. 137), exposing the rib which

was freed from muscular attachments without entering its periosteum; the intercostal muscles below and the attachments of scalenus anticus and medius being freed. The dissection was carried backward beneath the plexus and forward to anterior attachment of rib. The rib was then freed posterior to the plexus as far back as possible.

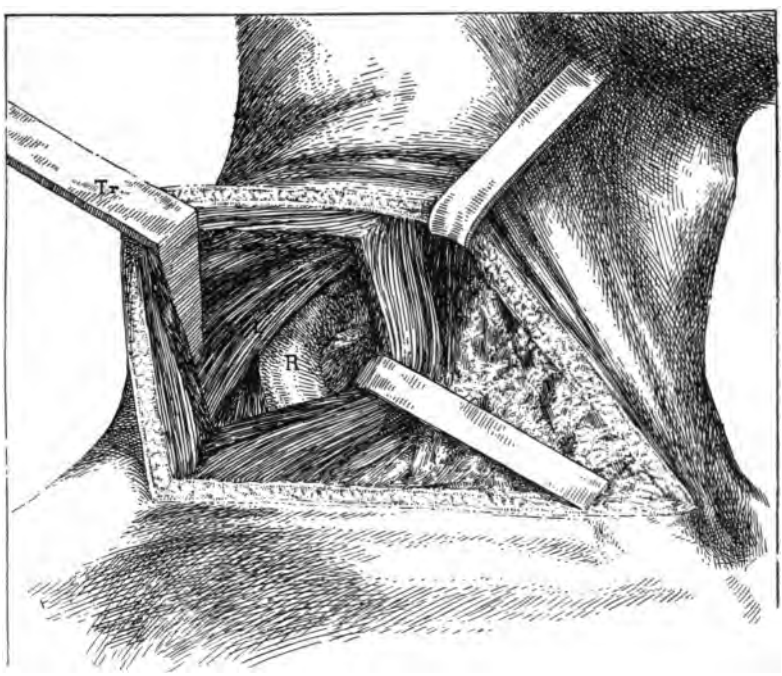

Fig. 138.—Operation for removal of cervical rib. Posterior part of incision retracted upward: *R*, Cervical rib to transverse process; *Tr*, retractor on cut surface of trapezius and (*L*) levator anguli scapulæ.

The parts were allowed to fall together anteriorly and the skin and fascia were freed at the posterior part of the wound and retracted well upward. A vertical incision was made through the muscles, namely, trapezius and levator anguli scapulæ, so that the angle and adjacent parts of the rib were freely exposed (Fig. 138). With bone forceps the rib was cut across without difficulty, including the tip of transverse process

of vertebra, leaving the head. Through the anterior portion of the wound the anterior attachment of the rib at sternum was then cut, also with bone forceps. In neither case could a Gigli saw be used on account of the depth, and the fact that anteriorly the rib was so overhung by sternomastoid and subclavian artery that the Gigli saw could not be used safely. Having cut both ends, the rib was readily drawn out through the posterior incision (Fig. 139). Care must be taken throughout the operation to avoid opening the pleura, and gentleness in retraction

Fig. 139.—Case II. Cervical rib after removal.

to avoid injury to the brachial plexus. There is little danger, however, of these complications if the dissection is carefully made.

Convalescence was uneventful. Wound healed *per primam.*

Late result, September 5, 1920: Patient feels well. No weakness in left arm. No swelling. General condition good. Three weeks after leaving hospital she returned to work. Scar well healed. No nervous symptoms. No limitation of motion;

no tingling or numbness of arm. This method affords easy access to the anterior portion of the rib and allows adequate removal of its posterior part.

Through the courtesy of Dr. Alfred S. Taylor (personal communication) I present the method which he employs, as it appears to have been satisfactory, especially for the removal of incomplete cervical ribs.

Taylor's incision begins over the insertion of sternomastoid muscle. It is carried upward and outward to the edge of trapezius muscle, bisecting the angle between the sternomastoid muscle and clavicle. The incision, according to Taylor, lies in the line of cleavage of the tissues, and therefore leaves little scar. The fat pad which lies in front of the plexus may be divided or displaced upward by blunt dissection. When the plexus is exposed the deep cervical fascia is divided along the outer edge of the upper roots so that the plexus may be lifted slightly forward and slightly inward, exposing the posterior and inner portion of the cervical rib. When the rib extends far forward the anterior portion can be approached through the anterior part of the incision. For a complete rib he advises dividing the rib somewhat behind the brachial plexus and removing the two portions separately. He leaves the head proper *in situ* to avoid damage to overlying vertebral vessels.

Taylor states that the great majority of his cases have been somewhat rudimentary ribs with a prolongation forward to the first true rib by means of aponeurotic bands. These bands, he states, often are as much the cause of symptoms as the rudimentary rib itself; they should, therefore, be resected. For these rudimentary cases the posterior portion of his incision answers for the entire resection.

Conclusions.—Operation is advisable when symptoms develop sufficiently severe to incapacitate the patient or to cause persistent suffering or annoyance.

To ensure a permanent cure the rib with its periosteum should be removed to the transverse process of the vertebra, otherwise regrowth of bone is likely to occur and cause recurrence of pressure symptoms.

By a combination of anterior and posterior methods of approach through a single skin incision, as in Case II, a complete rib may be adequately removed and permanent cure ensured.

CLINIC OF DR. JOHN A. HARTWELL

BELLEVUE HOSPITAL, SECOND DIVISION, CORNELL UNIVERSITY MEDICAL COLLEGE

SUTURE OF MUSCULOSPIRAL NERVE FORTY-SIX DAYS AFTER ITS SECTION BY STAB WOUND

THE first patient is a male, aged twenty-eight years, who was admitted to the service immediately after having received a stab wound in the left arm. Examination showed that a sharp instrument (presumably some type of knife) had entered the arm immediately above the extensor prominence, and had passed through the cubital fossa and emerged on the inner side just above the internal condyle. Some of the extensor muscles had been cut. An examination for injury of the musculospiral nerve failed to disclose this injury. There was disability at the wrist and to the fingers, so far as their extensor action was concerned. This was interpreted as being due to the damage to the muscles themselves. The sensation in the distribution of this nerve is recorded as having been tested, but it was not noted to be deficient.

The stab wound was treated in the usual way by thorough cleaning and suture. Primary union resulted. The patient left the service at his own request on the ninth day. He returned to the follow-up clinic a month later, at which time he showed the typical symptoms of section of the musculospiral nerve at the immediate site of the stab wound (Fig. 140). The muscles on the extensor side of the forearm and the abductors of the thumb showed some atrophy. There was a complete wrist-drop and a loss of power to extend the fingers. Sensory tests showed that there was a very limited loss of pain and tactile sense over the posterior portion of the thumb and of the web between it and the index-finger.

An interesting consideration in this case is the fact that the injury to the musculospiral nerve was originally overlooked. As stated, this was due to the misinterpretation of the muscular disability at the wrist, assuming that it was caused by the damage to the muscles themselves; and, second, as shown this morning, to the very slight sensory disturbance which not infrequently results from the division of this nerve, since there is such an overlapping of the median and ulnar nerves. This im-

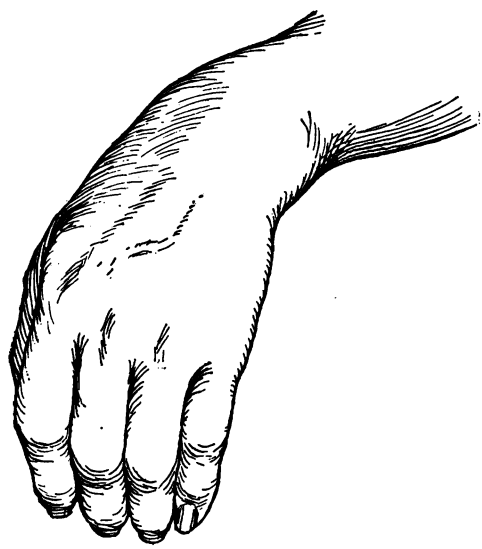

Fig. 140.—Showing complete wrist-drop due to severance of musculospiral nerve prior to operation.

presses upon us the necessity of making a rigid neurologic examination of such cases at the time of their injury.

The interval since the injury is now forty-six days. The procedure here will be to make an incision along the normal course of the nerve, as presumably we will find the divided ends with their bulbous formation in the scar tissue caused by the stab wound and the original repair, but in the normal line of the nerve. I shall first look for the nerve above the point of section. The easiest place to find this is where it emerges from behind the humerus and passes into the muscles above the external

condyle. On separating the muscles the nerve is seen in this position. The dissection, now carried down, brings us to its entrance into the dense scar tissue, and on dissecting this out we now have the free bulbous end at the point of division. On dissecting through the scar tissue we come here in contact with the distal bulb, and, dissecting it out, we find that it lies about an inch above the division of the nerve into its two main branches.

The problem now is to remove the bulbous ends of the nerve until we come to normal nerve tissue. This is best done by serial section, and the presence of normal tissue is determined by two observations: first, the fascicular appearance of the nerve, showing the different nerve elements of which it is composed lying in parallel bundles; and the second is well termed "blood sweating," which means, as we see here, the oozing of the minute drops of blood from the cut end. The loss of nerve tissue in this case will be very small, so that there will be no difficulty in bringing the two ends into contact by simply flexing the elbow and extending the wrist.

It is now important to bring the two segments of the nerve into their normal rotation relation, that is, so far as possible, the fasciculi of the proximal end must be placed in contact with the corresponding fasciculi of the distal segment. You will have noted that I placed an identifying suture in the perineurium of each segment before dissecting it out. In suturing the nerve care will be taken that these identifications lie in their normal positions; in other words, that there has been no abnormal rotation of either segment.

The nerve is now repaired by the use of this very fine silk, by interrupted sutures passing through only the neural sheath; and so accurately placed that all the fasciculi shall be within this sheath, and therefore in their regeneration will grow immediately in contact with the distal segment. The suture line seems very satisfactory in this respect.

We will now dissect free all the scar tissue, giving a good muscular bed for the nerve. Experience has shown that this is probably the least irritating of any tissue that can be used. As you will note, there is no tension in the line of suture with

the forearm and hand in their present positions. It is also seen that the forearm may be moved through an arc of 25 degrees before it throws any tension on the nerve. We will, therefore, close the wound and apply a molded splint to hold the limb in this position.

The subsequent treatment will be to leave the arm in this position for two weeks, at which time the splint will be removed and passive motion made through the 25 degrees that we have

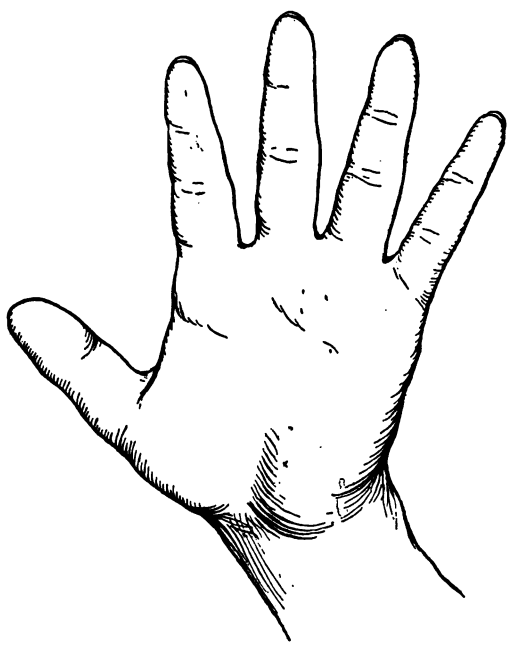

Fig. 141.—Present range of extension of wrist and fingers.

just demonstrated can be employed without throwing tension on the nerve. This will be continued for three weeks longer. Experiments have proved that at the end of five weeks the union of the nerve has the same tensile strength as the normal nerve. Accordingly at this time the splint will be removed and the patient instructed to gradually bring the elbow to full extension. The hand, however, will be retained in full dorsal flexion until the muscle power begins to return. Measurement shows that

the site of the section is from 90 to 125 mm. above the termination of the nerve into the various muscles that it supplies. We may therefore anticipate that a return of power will occur in from ninety to one hundred and twenty-five days, since regeneration takes place at the rate of 1 mm. per day.

Subsequent Note.—The plan as given above was followed out. Primary union took place. The elbow gradually regained its full arc of motion within two months. The hand splint was retained for a little less than three months, and the first evidence of a return of power actually occurred on the ninetieth day, according to the patient's own statement and our observation. At the end of six months the limb was entirely normal (Fig. 141), there being a complete return of muscular power and delicacy of movement to the forearm and hand; but there still remains a loss of sensation over the terminal distribution of the nerve around the thumb. This condition will last until regeneration has taken place throughout the entire length of the sensory elements of the nerve.

CHRONIC OSTEOMYELITIS

THE second patient presents an entirely different problem from the ones previously discussed. He is suffering from a chronic osteomyelitis, and gives the following history:

He is a man aged twenty-eight, who, two years previous to coming under our observation, suffered from what is said to be an attack of "acute inflammatory rheumatism of the back." Exactly what this may mean it is difficult to say, but the important fact is that one week after this illness he received an injury in the right scapular region by being caught in one of the automatically moved heavy doors of a subway train, receiving a rather severe blow at about the middle of the scapular spine. He suffered no immediate serious effect from this, but about six months later there appeared a swelling in the subdeltoid region which was painful and showed the evidence of a mild inflammation with suppuration. This was operated upon and the origin of the trouble was found to be a necrosis of the scapular spine about 1 inch from the acromion. The wound healed up rather slowly, and he remained well until about two months before coming under our care. At this time there appeared a fluctuant swelling just above the clavicle and he showed some evidence of constitutional poisoning. An incision was made in it and the resulting sinus has refused to heal; and from time to time small pieces of necrotic bone have been discharged from it. Examination at the present time shows this discharging sinus, and a probe passed into it travels deeply under the muscles and strikes against bare bone on the ventral surface of the scapula.

The *x*-ray shows what apparently is a fracture at the middle of the scapular spine, but may readily be osteomyelitis; and immediately below the spine there is a clear round shadow which the radiologist has interpreted—without knowing the history

—as a bullet wound through the scapula; with the history, we interpret it as probably a focus of complete necrosis.

The problem in this case, as in all similar cases of chronic osteomyelitis, is purely a mechanical one. We may with absolute confidence promise this patient a cure provided we are able to remove all the dead and infected bone and leave the tissues in such condition that muscular or other soft structures will readily fall in place to fill up the resultant bony defect. In the case of the scapula, as here presented, this should not be a difficult undertaking. You will readily see, however, that if we were dealing with a long hollow bone it might be anatomically a matter of great difficulty to find the necessary soft tissues which would readily fall into the defect. As you see, the probe strikes the scapula, as had previously been demonstrated, and at this point, about half-way to the scapula, is felt a small spicule of bone. With the curet I think we can dislodge this and bring it out through the sinus without enlarging it to any extent. It is now free and is here presented, and, as you see, is a piece of completely necrotic bone which has been working its way toward the mouth of the sinus and has traversed practically half the distance from the scapula to the front of the neck. Undoubtedly it is this small piece that has directly kept the sinus open; but from the fact that we now feel bare bone and the fact that the *x*-ray shows disease of the scapula, a permanent cure cannot be expected unless we remove all disease.

It will not be necessary to cut through the tissues transversely, as we know that it is only the scapula that we desire to attack. We will therefore make the incision over the spine of the scapula at the site of its disease—and here immediately below the spine is found the button of dead bone which the *x*-ray showed, and which on the dorsal surface is directly opposite the point that the probe strikes on the ventral surface. It will therefore be necessary to remove the entire thickness of the bone. This can be done with a chisel, and valuable information will be obtained in this step. As you note, the bone separates rather easily at a definite margin, which indicates that this is the line between the dead and living bone; and contiguous to

it we find the granulation tissue in the sinus at its deep end. Examination of the spine itself and of the upper border of the scapula shows that this also is partially denuded of periosteum, and the medullary substance in this direction appears to be infected. This is sufficient evidence that the osteomyelitis is invading this portion to justify its removal, particularly as it will not cause material disability to do so. Removal also will be done with the chisel, and, as you will note, there is again a distinct line at which the bone in its diseased portion easily separates from the normal. With the rongeur we will now remove all jagged pieces and also accomplish the mechanical necessity of leaving a bony defect into which the muscles that have been lifted from the spine will easily fall to obliterate it as soon as it is free from infection.

It is this type of case in which the Carrel-Dakin technic can be used with the greatest ease. We will therefore place the Carrel tubes accurately in all parts of this wound in this way, cover them with the Dakin-soaked gauze, and immediately begin the instillation of the Dakin solution at intervals of one or two hours; and this will be continued until the wound is surgically sterile.

The question now arises as to whether anything will be accomplished by suturing a portion of this wound in order to get early primary union. I am inclined to think that will fail, as this man is rather susceptible to the staphylococcus infection, and it is quite likely that the stitch tracts will become infected. If we have been successful in removing all the dead and diseased bone and the infecting organism is, as we assume, a Staphylococcus aureus, we may hope to accomplish such sterilization in a period of two to three weeks, and, failing that, a cure may be anticipated in the length of time necessary for a wound of this size to heal, which will probably be another four weeks.

Subsequent Note.—The culture taken from the small fragment of the bone at the central portion of the lesion developed pure Staphylococcus aureus. The wound followed the anticipated course. There was a rather severe staphylococcus in-

fection of the suture tracks which necessitated the removal of the sutures on the third day, throwing the wound wide open. This demonstrated that it would have been fully as well not to have sutured the wound at all, as discussed at the time of the operation. No evidence of uncovered bone could be determined after the fourteenth day.

This case is a practically typical example of a patient who has a low resistance to Staphylococcus aureus. His attack of "acute inflammatory rheumatism of the back" was undoubtedly the beginning of his infection in the scapula. It is possible that he might have thrown this off had he not received the subsequent injury, but the two combined were more than he could overcome, and the classical subacute osteomyelitis resulted. The case illustrates in every respect the principles involved in the pathogenesis and treatment of this common affection. It is curable in most instances if these principles are thoroughly understood and our therapy is carried out along the proper line.

ACUTE EMPYEMA

OUR third case is one of acute empyema, a subject of unusual interest at the present time. It differs, however, from the usual postpneumonic empyema, in that there is also present a pneumothorax.

The patient is a man forty-two years of age, who was admitted to the medical side on December 20, 1920, with a typical lobar pneumonia of both lobes of the left lung. The sputum showed Type II pneumococcus. The patient ran a very severe course of pneumonia and did not properly defervesce. On the tenth day he developed signs of fluid in the left chest; and on the eleventh day an aspirating needle showed the presence of thick pus and air in the left pleural cavity. He was transferred to the surgical service, and the *x*-ray and physical signs at that time showed that there was an almost complete obliteration of the left thoracic cavity by a pyopneumothorax. The heart was pushed far over to the right and the lung was compressed almost completely around its root. The patient's general appearance, his previous history, and the development of a pneumothorax as well as a pyothorax, strongly indicated that the patient might be suffering from tuberculosis, as a pneumothorax following a definite pneumonia is uncommon.

Repeated examination of the sputum, however, failed to show tubercle bacilli. This negative finding did not convince us that tuberculosis could be excluded, and accordingly we were unwilling to convert the condition into an open draining chest cavity, because where tuberculosis is present this inevitably leads to a chronic suppurating tuberculous empyema which it is almost impossible to cure. Therefore, after thoroughly studying him, it was decided to empty if possible the chest cavity by means of suction drainage. This was done fourteen days ago by the method we regularly use in this clinic. It is simple and effective. Under local anesthesia, at the selected site (in this case the eighth interspace of the scapular line), an incision is carried down

to the pleura, in which a small nick is made, and through this is passed a firm moderately large fenestrated tube into the pus-containing thorax. The end of this tube is kept controlled with a clamp. It is fastened at the proper depth with a suture placed in the skin. The wound is very firmly packed with well-vaselined gauze and a copious dressing is tightly strapped around it. This simple device makes an air-tight joint which will remain air-tight usually from one to two weeks. The open end of the tube is then connected with a water bottle, one glass tube of which passes under the surface of the water, and the second acts as a pressure equalizer. The pus will drain from the chest into the water bottle, but on inspiration the water rises in the tube and acts as a valve to prevent the entrance of air. In this particular patient this arrangement remained air-tight for about ten days, during which time he drained a continuously decreasing amount of pus—there being 21 ounces on the first day and 2 ounces on the ninth day. His temperature during this period changed from its previous daily excursion of 98° to 102° F. to a maximum rise of 100° F. During the ten days he maintained a good negative pressure, as determined by the rise of water in the water-valve tube. The physical signs and the x-rays show that there has been an expansion of the lung and a change of the heart position toward the normal, so that the remaining cavity in the chest is now not more than an estimated one-fourth of its original size.

The problem that presents itself today is whether we shall consider the patient as on the road to complete recovery without further operative procedure. We believe that experience has amply demonstrated that such is not the case. One of the most potent causes of chronic empyema is inadequate drainage. This patient has been complicated by a frank pleural fistula, as shown by the presence of his pneumothorax. We have no certainty that it is as yet completely healed, although the expansion of his lung is a strong indication that it has. However, the small drainage opening that he has from the first operation cannot be considered adequate to get rid of the remaining pus, with a complete expansion of the lung.

We will therefore proceed to resect a sufficient amount of rib to assure the constant emptying of this cavity. This is done by the classic procedure, except that we will remove the periosteum because it is found in many cases that a regeneration of bone may interfere with the drainage for a sufficiently long period, and in any case it is a complicating factor in maintaining a wide opening. On palpating the chest cavity through the opening we find that the lung can now easily be reached, but there still remains a large anterolateral cavity extending from the diaphragm to the apex of the lung and lying to the left of the heart. We will place one large double drainage-tube and await further *x*-ray study on the progress of the case to determine subsequent treatment.

In general, however, it will be to keep this cavity thoroughly drained, and to prescribe calesthenics and pulmonary gymnastics in order that expansion of the lung may take place as rapidly as the cavity becomes clean.

You will naturally be interested in the question of the use of Dakin's solution in this case. You will recall that the patient had originally a pneumothorax which, as stated, means a bronchopleural fistula. Therefore it would be inadvisable to put Dakin's solution in this cavity except under precautions which will not flood the lung with the solution in case the fistula is still patent. Our procedure will be to permit drainage to take place for a period of five or six days, and then cautiously introduce a small amount of Dakin's solution. If the bronchial fistula is still patent, it will be immediately indicated by the passing of the chlorin gas into the patient's larynx, with the resultant violent coughing. This finding will absolutely contraindicate the use of the Dakin solution. If, however, no such symptom arises, we may conclude that the fistula is closed, of which we already have evidence by the expansion of the lung since the first operation, and we may then proceed to use the Dakin solution in the accepted way. In this clinic we are thoroughly convinced that the proper use of this solution, carefully safeguarded, is a very great aid toward producing sterility of the cavity, and that when sterility is produced we may confidently expect (if no other

complications be present) that the lung will expand to entirely fill the chest cavity and that a complete cure will result. You will recall that I am now discussing *acute* empyema, and bear in mind that the problems presented by chronic empyema are quite different.

Subsequent Note.—The procedure above indicated was followed out. The use of the Dakin solution indicated that the bronchopleural fistula had closed. The capacity of the cavity ten days following the second operation was still 300 c.c., but the bacterial count of the discharging pus dropped from infinity on the eleventh day to 4 on the thirteenth day and to 2 on the fifteenth day—the time that this note was made. The patient's general condition is excellent, and we have every reason to hope that his progress will continue as above outlined.

CANCER OF THE RECTUM

THE patients to be operated upon this morning are all suffering from gastro-intestinal disease. The problems are quite different from the cases operated upon last week.

The first patient for operation this morning is a man seventy-two years of age, suffering from cancer of the rectum. It is important to note that the history of this condition extends over a period of less than six months, though undoubtedly the lesion has been growing for a much longer period. The first symptom he noted at that time was the development of a diarrhea with from three to eight stools a day, in some of which he noted blood. With this condition he suffered from tenesmus, which was rather constant. He has lost 20 pounds in weight since the summer.

It is important to emphasize that this history is rather typical of carcinoma of the rectum, though in many cases the growth will advance much further than we believe it has done in this instance, with even less marked symptoms. The importance of this lies in the fact that approximately 50 per cent. of the patients presenting themselves for operation in this condition are so far advanced in the disease that radical operation is impossible.

The diagnosis in this case is easily confirmed by a digital examination of the rectum; 4 inches above the anus there is felt an ulcerating mass with crater-like characteristics, which bleeds easily upon examination, but does not obstruct the bowel. It will be noted that no *x*-ray has been taken. The reason for this is that the diagnosis is certain without it, and in this clinic we have a strong feeling that the use of bismuth or other opaque substances in the intestinal tract, where there is marked interference with the proper propulsion of the fecal content along the intestinal canal, should be avoided. We have had experiences in which the bismuth mass has piled itself up behind a partial obstruction and thus has been a serious handicap at the time of operation.

The problems confronting us in cancer of the rectum at this site are two: (1) Is the patient suffering from distal metastasis that makes cure impossible? (2) Is the local condition such that the growth cannot be removed without too great danger to life or of destruction of necessary organs, for example, the bladder and ureters?

It is our belief that these questions can be answered only by an inspection within the abdomen, and therefore in all cases our first step is to open the abdominal cavity. It is the rule to find the earliest metastases in the liver, so that this organ is first examined. The local growth is then palpated and a decision reached as to its operability.

We believe that any cancer of the rectum which can be reached by the examining finger cannot be cured except by a removal of the entire lower segment of the rectum, including the anal sphincter. A study made by the operator some years ago, and published in the Annals of Surgery, showed that an attempt to remove these growths with preservation of the sphincter resulted in a very large percentage of local recurrences or severe stricture. You will please bear in mind that I am referring to cancers situated at or below the peritoneal reflection. Those situated higher, about or above the rectosigmoid junction, present a different problem with a different solution.

We will now open the abdomen in its lower part by the incision that we have found most satisfactory, namely, through the middle of the left rectus sheath, from the umbilicus downward to the pubis. The rectus muscle is then drawn out from the midline, thus preserving intact its blood and nerve supply, and the posterior sheath is opened a short distance from the midline. On repairing this abdominal incision all the structures may be placed in their normal relations, and it has been our experience that hernias do not occur. Incidentally it may be remarked that this same incision is used in the upper abdomen for our gastric and gall-bladder surgery for the most part.

Exploration.—We will now explore the liver, which, you see, can easily be done by passing the entire hand through this incision. The liver is normal in size and consistency, and is

reached easily in all its parts. Metastases, when present, show themselves by small or larger nodules situated beneath the peritoneum and are easily recognized. The total absence of this condition is sufficient evidence that the liver is not involved, therefore we may proceed, with the hope that the patient is amenable to cure. Examination of the tumor itself shows that it involves the rectum at the peritoneal reflection. It is moderately adherent at the base of the bladder, and at one point shows on the peritoneal surface of the bowel, where it is obviously ulcerating through, but has not, as yet, involved any other tissue. We find that it is movable in the hollow of the sacrum, and we therefore conclude that there will be no difficulty in removing it. No lymph-nodes can be palpated.

The problem that now confronts us is to completely remove the growth and all the lymph-nodes draining it, even though they are not palpable; the three dangers that must be avoided are: first, undue shock from a too prolonged operative procedure; second, loss of blood; third, later sepsis from contamination and improper drainage of the large traumatized operative field. We therefore proceed in an orderly manner to avoid these specific dangers.

We first determine that by dividing the bowel about 5 inches above the growth we will be able to take out the segment of the sigmoid and rectum below it with all the regional lymph-nodes and will have an ample amount of sigmoid remaining to establish our left inguinal colostomy, which will be the permanent outlet for the fecal content. It is well known that any soiling from the sigmoid content is very prone to produce severe infection; therefore we avoid opening the bowel until the last step in the procedure. The mesosigmoid is divided on either side and reflected back laterally, after thoroughly protecting the rest of the abdomen with the pads. The sigmoid is then raised anteriorly, the superior hemorrhoidal vessel ligated at the point determined for section, and all other smaller blood-vessels are ligated at the same point. We have thus controlled completely all serious bleeding, much as is done after ligation of the uterine

arteries in a hysterectomy. In fact, our procedure throughout is very analogous to this operation.

The lateral incisions in the peritoneum are now carried down to the Douglas pouch and anteriorly through this reflection, to expose the posterior surface of the bladder and the anterior surface of the rectum below the peritoneum. The dissection then proceeds on either side until the ureters are completely identified and exposed to their entrance into the bladder. The sigmoid is then raised from its posterior bed and the dissection is carried well down into the coccygeal hollow behind the rectum. We now lift the bladder, the seminal vesicles, and the prostate from their relation to the rectum. This, as you see, carries us well below the growth which is now completely mobilized, and we can follow the ureters into the bladder, so that we are sure that we have avoided damaging them.

The entire cancerous area with its lymph-nodes is now free from the point chosen for section down to the pelvic outlet. Since we are to do this operation in one sitting, it is important that the entire abdominal procedure be carried as far as this, otherwise our second step would prove unduly difficult.

We now proceed to make an ordinary intermuscular incision in the left flank for the purpose of establishing the colostomy. Next, the peritoneal floor is completely repaired except for the point through which the rectum still passes, around which a purse-string suture is placed for later tying. The bowel is now divided between two crushing clamps with the cautery—every care being taken to prevent soiling—and is burned close to the bite of the clamp. Each end is closed with an inverted purse-string suture, and the proximal end is passed out through the opening made for the colostomy and anchored at that point. The distal end is dropped into the pelvic cavity below the repaired peritoneum and the purse-string suture tied, thus completely closing off the peritoneum from the portion of the bowel to be removed. You will see that we have thus avoided two of the dangers, first, hemorrhage; second, soiling from the bowel content, as the bowel was opened only at the very conclusion of the operation under every possible precaution.

The abdominal wound is now repaired in its normal relations and, since the patient's condition is entirely satisfactory, we will take pains to carefully suture it, using for the most part chromic gut, with silkworm-gut for the skin, which also reinforces the fascial suture. We have so far taken an hour and a half for the operation. Our patient is in good condition, and as the remaining procedure will not require more than fifteen minutes we may immediately proceed to it.

The patient will be placed in a very exaggerated lithotomy position, so exaggerated that the plane of the perineum is horizontal and very considerably elevated above the body. This makes our procedure very much easier and at the same time prevents loss of blood from venous oozing. A sound is passed into the bladder. An incision starts in the midperineum, passes backward, encircling the anus on either side (which has been closed with a purse-string suture so as to prevent soiling), and is carried backward beyond the coccyx. The incision is deepened anteriorly until we reach the urethra, laterally until the levator ani muscles are encountered, and posteriorly into the coccygeal hollow. With blunt dissection you now see that it is an easy matter to pass upward until we come into the hollow of the sacrum, where we find lying the bowel already loosened from above. My finger now exposes the prostate, which, as has already been stated, was dissected free from the rectum in the abdominal section. I now grasp the free bowel from above and have the growth in my hand, and by gentle traction it can be drawn entirely out through the perineal wound. There are only one or two lateral blood-vessels passing near the levator ani muscles at this point which it is necessary to clamp and ligate. The final dividing of these attachments frees the entire rectum, and we have the large subperitoneal cavity widely open before us. This we will wash out thoroughly and then pack loosely with well-vaselined gauze, which will be sufficient to control the oozing and allow the escape of any septic material, and can easily be removed in forty-eight hours, after which the whole cavity will be irrigated daily.

The operation is finished under two hours and the patient's condition is very satisfactory.

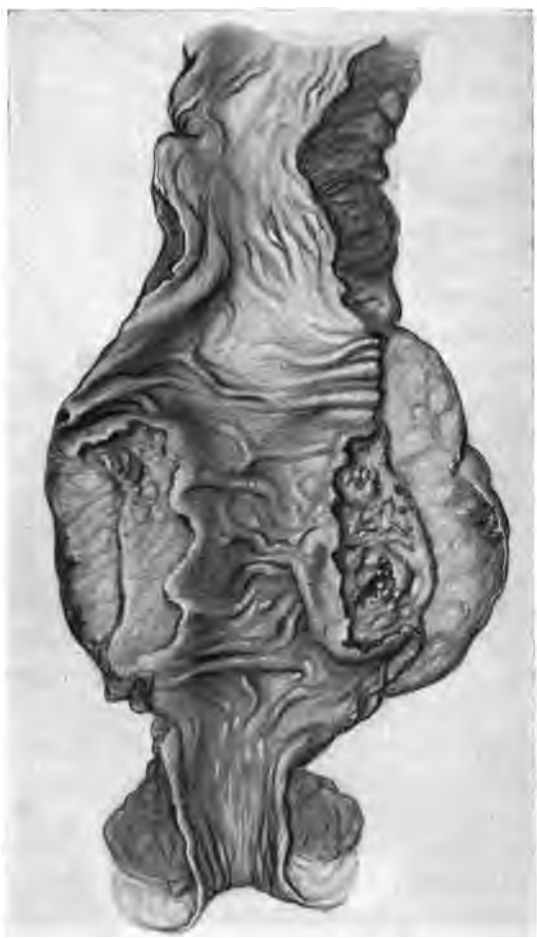

Fig. 142.—Cancer of the rectum. Sectioned through the middle of the growth longitudinally. Note the uninvolved portion of rectum in central portion of figure.

In this instance I shall now open the colostomy and insert a large tube into the bowel to establish immediate drainage, be-

cause it is noted that there is a very considerable amount of intestinal blocking due to the imperfect emptying of the feces previously.

Examination of the specimen shows you the ulcerated crater with the muscularis and peritoneum involved, as already stated (Fig. 142).

It may be of interest to you to discuss the advisability of doing this operation in two sittings. The operator is strongly of the opinion that where possible it should be done in one sitting. We have had a considerable number in this clinic and have always been able to conclude the operation within two hours, and in no case has the patient been in undue shock. When done at two sittings we feel that there is always the possibility of severe sepsis arising from the portion of the bowel that has been freed and placed in the subperitoneal sacral hollow. In spite of every care, there will be sufficient contamination of this seriously traumatized area to allow a very serious infection, particularly as many of these cases come to operation only when the cancer has ulcerated a considerable distance through the bowel wall. Such a condition in a more or less debilitated patient is ideal for the development of a septic state in the interval between the first and second stages, and, as before stated, one of the great dangers to these patients is sepsis. If done at one stage, as here illustrated, the lower cavity is widely drained and this danger is avoided. In case, however, for any reason it is deemed necessary to do the two-stage operation, I must caution you against carrying the dissection of the first stage as far downward as was done this morning. This will inevitably result in too great a denuded area, so that without the lower drainage the probability of serious sepsis is too great to risk.

The microscopic examination showed the lesion to be an ulcerating malignant adenoma. No lymph-node involvement could be found.

Subsequent Note.—The postoperative course of this patient was very satisfactory. The anterior abdominal wall healed, except for the skin, *per primam;* the colostomy functioned nicely, and in ten days the posterior wound was a clean granulating

surface, which will close within a month or six weeks. Since the growth was adequately removable and no lymph-nodes were involved the permanent prognosis is more than fair. Malignant adenomas are, as a rule, not distantly metastatic and complete local removal gives hope of a permanent cure.

NON-TUBERCULOUS INFLAMMATION OF THE CECUM

THE second patient for operation this morning is a boy aged fourteen whose history and examination suggest, but fail to positively determine, the diagnosis. The only symptom from which he has complained is that of mild recurrent attacks of abdominal pain during the previous year. In general, this pain seems to center in the region of the appendix, but has never been severe enough to confine him to bed until the present attack, which began four days ago. This has been rather more severe and has been accompanied by vomiting on one or two occasions, but there has been no irregularity of the bowel.

The patient is an Italian; as you see, of rather frail build, and possibly what we recognize as a tuberculous type. His temperature has not been elevated above 99.5° F. during his three days' stay in the hospital. His leukocyte count is 17,000, with 66 per cent. polynuclears.

The physical examination reveals entirely normal conditions except that the abdomen shows some general rigidity, very moderate, however, in amount, and tenderness on deep palpation in both lower quadrants; but rather more marked on the right. A sensation of doughiness is noted as being present on palpating the abdomen. There is believed to be a mass in the region of the cecum, but this has not been definitely made out. Because of the chronic course of the disease, the doughy sensation, the boy's nationality and general appearance, the diagnosis of tuberculosis of the cecum has been suggested rather than a simple appendicitis, and therefore I shall make an incision which will permit a more radical operation if this proves to be the case.

Palpation under ether reveals a rather definite mass which is movable, and I believe strongly tends to confirm the diagnosis. We will make the same incision as was used on the first case, except that it will be done upon the right side. This gives us free access to the cecal region without undue retraction, and

permits us to lift it with the appendix into view. You note that the appendix is a rigid, erect organ, very much thickened, shows the evidence of a chronic inflammatory process, and near the base you may note a chronic perforation. There is, however, absence of suppuration in the surrounding tissue, and the cecum is very markedly involved in the process. The lymph-nodes in the mesentery of the ileocecal junction are enlarged and succulent.

We are now presented with a pathologic problem of difficulty. This condition may be due to tuberculosis or simply to pyogenic infection. Obviously, the disease has involved the greater part of the cecum, the wall of which is thickened I should say nearly $\frac{1}{2}$ inch. It is very hard. There is absence of any evidence of tuberculosis in the rest of the peritoneum. We particularly note the absence of miliary tubercles on the peritoneal surface.

This lesion may occur as the result of ulceration in the cecal mucosa of non-tuberculous as well as of tuberculous character. The question therefore arises: Will this boy recover if we remove the obviously diseased appendix and trust that there is no ulceration within the cecum, but that the cecal involvement is pyogenic in origin and will resolve if the appendix be removed? It will not do so, of course, if the tubercle bacillus is the exciting cause. All things considered, I am inclined to believe that the best procedure is a removal of the entire cecum, adjoining ileum and colon, and will therefore proceed to that operation.

For this purpose it has been amply demonstrated that it is wiser to remove all of the colon that has not a well-developed mesentery, which means usually (and does in this case) up to the hepatic flexure. We may then do anastomosis between the ileum and the colon in a portion of the latter well provided with peritoneal covering, which will aid materially in closing the sectioned end of the colon and making a lateral anastomosis. The incision, therefore, will be carried upward sufficiently to expose the hepatic flexure, still preserving the abdominal wall, as mentioned in the previous case. The portion of the bowel to be removed is now mobilized by dividing the outer leaf of the mesentery and ascending mesocolon, which gives us ready access

to the blood-supply of the part of the bowel to be removed. These blood-vessels are now clamped, the bowel is lifted forward and inward, the inner mesenteric leaf is divided, and thus we lift the entire cecum, ascending colon, and about 4 inches of the ileum outside of the abdominal cavity.

The peritoneum is now thoroughly protected, and the bowel is divided 3 inches from the ileocecal valve and again at the hepatic flexure. You note that I am dividing the bowel in this case with the knife rather than with the cautery, and that my protecting clamps are not tightly compressed. I believe that these steps are important because a cauterized bowel does not seem to me to heal as kindly and firmly as when sectioned with the knife. We will now close the open end of the bowel by an overwhipping stitch of chromic catgut and a further inversion under three layers of chromic gut inserted after the method of Lembert. It is of the utmost importance that great attention be paid to the closure of these blind ends of the bowel, since they are very prone to leakage. A side-to-side anastomosis is made by the usual method, as employed in gastro-enterostomy, with the blind end of the ileum and the colon both pointing toward the right. The stoma, as you see, is about 1 inch in diameter, and so far as can be determined we have accomplished a complete closure so that no leakage should take place. Of this, however, my experience does not make me very confident, as I have seen a number of cases in which leakage did take place when the large bowel was involved, even though every care was taken to avoid it.

We will now close the posterior peritoneum and place the omentum around the site of the anastomosis, thus leaving the intra-abdominal contents as nearly normal as our operative procedure will permit. The abdominal wall is closed by the same method as used in the other case, without drainage except in its superficial part, trusting that if leakage does occur it will find its way along the omentum to the surface or will wall itself off in such a way that a future drain may be used. The reason for adopting this course is that any drain, to be efficient, must necessarily lie close to the anastomosis or the closed ends of the

gut. If by chance the drain comes in contact with the suture line, it undoubtedly tends to aid leakage, therefore we feel safer in not employing it.

The specimen, as you see, shows the condition already described (Fig. 143). On opening the appendix it is seen to be tremendously thickened and is necrotic at its base, with the

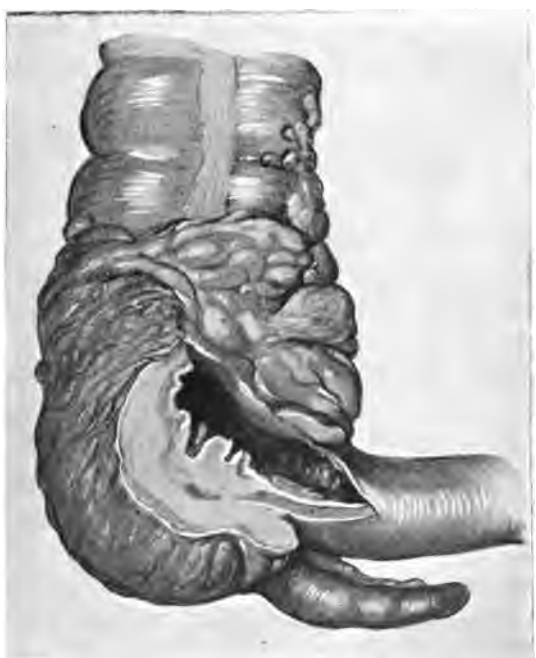

Fig. 143.—Lesion involving the appendix and the cecal wall. Note the extensive fibrosis which failed to reveal evidence of tuberculosis. All the coats were involved.

chronic perforation already mentioned. There is nothing that proves that this case is tuberculous, and there is no ulceration inside of the cecum, though, as you see, the disease involves its wall over a very considerable area. We shall have to wait for the pathologic report to decide the question as to the etiologic factor.

Subsequent Note.—Very careful examination of the cecum

and the appendix failed to give any proof of tuberculosis. The process was a chronic inflammatory one without the formation of tubercles or giant cells; but even with this we believe it unsafe to say that the case is not tuberculous because—as amply shown in the literature—many of these cases later develop a tuberculous peritonitis or more extended section proves some spot in which the tubercle bacillus has been active. The German authorities are inclined to believe that there is a tuberculous element in all cecums of this type.

This patient did develop a fecal leakage, which, as we had hoped, readily found its way along the omentum to the abdominal wall and drained outward through the wound. It remained open for about eight weeks, with very moderate leakage, and spontaneously closed.

CHRONIC GASTRIC ULCER

Our third patient is a woman aged forty-seven who presented herself with the typical history of gastric ulcer, which is confirmed by the *x*-ray findings as shown on this plate (Fig. 144). The defect as seen by the fluoroscope is here demonstrated in

Fig. 144.—Filling defect with permanent incisure opposite to it. Note the high position of the ulcer on the lesser curvature.

the middle portion of the lesser curvature and is of very considerable extent, reaching upward toward the cardia.

For the approach of this lesion we will use the same incision as in the two previous cases, except that I shall go through the left upper rectus because I anticipate greater difficulty near the cardia than at the right end of the stomach. The lesion here is

well demonstrated and, as you see, involves an area on the lesser curvature about 3 inches in extent, passing on to both the anterior and posterior walls. It reaches to the vertical portion of the cardiac end of the lesser curvature. Of course, cancer cannot be excluded, but the history (lasting over a long period), the patient's general condition, the localized nature of the lesion, all point to non-malignancy.

The problem before us is as to the best type of operation. There are three courses open to us: we may either excise the ulcer and repair the defect, or we may do a so-called sleeve resection of the central portion of the stomach, including the ulcer; or we may do a subtotal gastrectomy. The pros and cons of these procedures are fairly well established, but still admit of very considerable discussion. If a simple excision of the ulcer be done, there will be great difficulty in closing the most proximal portion of the lesser curvature, as it is rather inaccessible. Moreover, the repaired stomach will be greatly deformed, and there is a good deal of evidence that excision of this portion of the stomach with local repair results in a serious motor disability of the stomach. The ultimate result, therefore, may be a badly functioning organ which even a gastro-enterostomy will fail to totally obviate. Further, there remains behind a portion of the stomach which may be the seat of subsequent ulceration, and, of course, if the lesion prove to be malignant we have failed to cure our patient. For these reasons this operation does not seem advisable here.

The sleeve resection is fraught with too much operative difficulty, as it will be almost impossible to make a perfect end-to-end closure so far up on the lesser curvature. Therefore we shall proceed to do a subtotal gastrectomy. This will be the easiest of execution, and I believe involves less risk to the patient, and it will have the great advantage of removing both the ulcer and the ulcer-bearing portion of the stomach. The resulting condition has proved to give an exceedingly good function, and is probably less liable to gastric disturbance than the less radical procedures discussed.

This operation proceeds on well-established lines. The gas-

trohepatic and gastrocolic omenta are opened; the blood-supply of the portion to be removed is clamped; and, as you now see, the stomach is mobilized. The difficulty lies in the highly situated cardiac lesser curvature, and in order that this may remain well within our reach I shall anchor it with this simple stitch before placing my clamp and excising the stomach. Now, by placing one clamp just distal to the pylorus and a second one on the portion of the stomach to be left, the intervening part of the stomach is excised. We may now proceed to the re-establishment of the gastro-intestinal tract, either by closing the duodenum and the open end of the stomach and then doing a gastro-jejunostomy; or we may do the gastrojejunostomy after the Polya-Reichel method, using a portion of the open end of the stomach for the anastomosis; or by the method recently advocated by Moynihan, in which the anastomosis is made between the whole open end of the stomach and the side of the distal segment of the jejunum, which is sectioned about 8 inches from the pylorus and its proximal open end implanted laterally into the distal segment about 3 inches beyond the gastrojejunostomy opening. Moynihan thus avoids the possibility of a vicious circle and has the drainage of the bile and pancreas into the jejunum without passing above the anastomotic stoma. This he believes to be a distinct advantage, but it is obviously a considerably greater operative procedure.

In this instance the best procedure seems to be the first named, and I am, therefore, closing the stomach with a lock chromic gut stitch for hemostasis, and reinforcing this with the usual overlying peritoneal stitch. The end of the duodenum is similarly closed. The jejunum now rises close against the stomach, as you see, but will pass more easily if it is drawn through the transverse mesocolon, as thus illustrated. The mesocolon is now stitched firmly to the stomach wall and enough on the stomach so that the anastomosis lies well below. The anastomosis, as you see, is done in the at present accepted method of an internal lockstitch of chromic gut reinforced with a peritoneal chromic gut stitch. The resulting stoma lies slightly on the anterior wall of the stomach, which seems to give the most

satisfactory anastomosis, and is sufficiently large to admit two fingers.

Our closure of the stomach wall at that difficult point on the lesser curvature has been very satisfactory, which seems to justify the adoption of the method followed. The abdominal wall is closed in the method already described, and no drain is used.

The specimen (on turning it wrong side out, as you see) reveals the ulcer corresponding exactly to the *x*-ray findings.

Fig. 145.—Perforating gastric ulcer showing penetration and craterlike formation through all the coats. Note extensive thickening and the amount of stomach removed.

It has perforated through to the peritoneal attachment of the lesser curvature, and there is an extensive area of induration surrounding it. On section, however, it lacks the characteristic appearance of malignancy, and will probably fail to show cancer under the microscope.

Subsequent Note.—Microscopic examination later proved the lesion to be a simple ulcer, with no evidence of malignancy. The patient's convalescence was without incident of any kind,

and an *x*-ray examination at the end of three weeks shows the stomach functioning well and the stoma draining from what now is apparently the most distant and dependent portion of the

Fig. 146.—After subtotal gastrectomy. Note the extent to which the stomach has dilated as a food reservoir. Emptying is complete in the normal time.

stomach (Fig. 146). This confirms the statement already made that, as a rule, subtotal gastrectomy leaves a very satisfactorily functioning organ.

CLINIC OF DR. ALLEN O. WHIPPLE

PRESBYTERIAN HOSPITAL

SURGERY OF THE BILIARY TRACT

Cases for Postoperative Discussion: I, II, and III. Case for Operation: IV.

CASES FOR POSTOPERATIVE DISCUSSION

Case I.—J. G., male, fifty-eight. History No. 49,139. Admitted November 22, 1920.

Chief Complaint.—Discharging abdominal sinus. Pain in right upper quadrant.

Past History.—He was operated upon twenty years ago for gall-stones. A large stone was removed. Gall-bladder was drained. No history of typhoid. Lues denied. Neisser infection thirty years ago. Following the operation he remained well and free from digestive disturbance for seventeen years.

Three years ago he began to have discomfort in the region of the scar and noted a gradually increasing swelling in the scar. In May, 1920 he was operated upon for repair of a ventral hernia. There was a moderate infection of subcutaneous tissue of the wound, but it healed without impairing the hernia repair. Three weeks after the wound had closed two sinuses developed. One of these persisted and discharged intermittently mucous and at times calcareous material.

For six weeks preceding his last admission to the Presbyterian Hospital he had been having attacks of cramplike pain in right upper quadrant, radiating to right scapula. These attacks were accompanied by no vomiting, but belching of gas. Bowels were not clay colored. No jaundice. No loss of weight.

Physical Examination.—A well-nourished, rather obese man

of middle age. He did not appear to be ill. Color good. No jaundice of scleræ or skin.

Pupils: Unequal, right pin-point, and did not react to light.

Tongue: Moist, coated.

Teeth: In poor condition. Moderate pyorrhea.

Heart: Normal.

Lungs: Normal.

Abdomen: A scar was present, oblique, 19 cm. long parallel to the costal margin; 8 cm. from its right extremity a fistulous opening was seen discharging a mucopurulent material. The discharge increased with pressure under the costal margin in midclavicular line. Here there was a moderate tenderness on deep palpation.

Knee-jerks: Active and equal. No Romberg. No ataxia.

Laboratory Findings.—Wassermann reaction negative in both antigens. W. B. C. not elevated.

Duodenal intubation unsuccessful because of hyperesthetic pharynx.

x-Ray examination, with opaque catheter in the fistulous tract, showed the catheter passing upward and to the midlinef No shadows of calculi were seen. A probe, passed a distance o. 10 cm., gave a gritty feel.

The points of interest and those to emphasize in this case are:

1. A cholecystostomy with freedom from symptoms for seventeen years.

2. Recurring symptoms of distress in right upper quadrant with development of hernia. At the time of the second operation—the one for hernia repair—the operating surgeon recorded in the history that there were numerous old adhesions between anterior parietal peritoneum and the gall-bladder, *i. e.*, a marked pericholecystitis. But every effort was made to avoid traumatizing the gall-bladder. The removal of it then was not considered, inasmuch as the purpose of the operation was hernia repair and primary union. Nevertheless, probably as a result of latent infection in the severed adhesions, some infection occurred. But this cleared up, to be followed later by the appearance of a fistula in the scar.

3. Appearance of gall-stone colic for six weeks preceding the last admission, typical in type and radiation of pain.

4. Irregular pupils, but active knee-jerks. Absence of ataxia. Negative Wassermann.

With this history and these clinical findings a definite diagnosis could be made with positive assurance that it would be confirmed at operation. There are many biliary conditions where it is impossible to make a flat diagnosis, but in a case of this type the correct one should always be made.

DR. WHIPPLE: What lesions did he have?

STUDENT: Chronic cholecystitis with fistulous opening.

DR. WHIPPLE: What kind of a fistula would you call it?

STUDENT: Mucous fistula.

DR. WHIPPLE: That is correct. Not a biliary fistula. What is the origin of the mucous fistula?

STUDENT: The gall-bladder.

DR. WHIPPLE: Exactly. Here was a case of persistent mucopurulent fistula with absence of bile in the discharge and absence of jaundice. He presented the factor of obstruction and the factor of infection, in combination, and illustrates in an ideal manner the principles underlying the lesions of the biliary tract as we discussed them in conference. Where would you localize the obstruction, and what might cause it?

STUDENT: Scar tissue in cystic duct.

STUDENT: Gall-stone impacted in cystic duct.

STUDENT: Adhesions about the duct.

STUDENT: Catarrhal inflammation of the duct.

DR. WHIPPLE: I suppose "catarrhal" is an allowable term, but it is a terribly abused word, and I should avoid it in medicine. The first two causes given are the most common, *i. e.*, causes in the lumen and in the wall of the duct. Causes outside of the duct can be ruled out. With regard to adhesions about the duct, it is my impression from hearing some of your discussions in conference that many of you have an erroneous idea of or a nebulous idea of adhesions outside of such structures as the cystic and common ducts. These ducts do not kink easily and scar tissue has to involve the actual wall of the duct to

cause obstruction. The term "adhesions," like "catarrh," is an abused one, and should be used intelligently. Edema of the duct would not act over so long a period. When obstruction is caused by mucosal edema it is usually only temporary.

The purulent character of the mucus and the tenderness over the gall-bladder region implied infection of the gall-bladder. The gritty sensation transmitted by the probe indicated gall-stone, as did the history of passing calcareous material by the fistula. The absence of gall-stone shadow meant nothing. The diagnosis of gall-stones should never depend upon their appearance in the *x*-ray plate.

Therefore, obstruction in the cystic duct, due either to stone or scar tissue, a chronic inflammatory process in the gall-bladder, uninvolved common duct, were the findings to be expected, and the history shows the preoperative diagnosis, given just before beginning the incision, was: mucous fistula of gall-bladder; chronic cholecystitis; cholelithiasis; stone in cystic duct.

The write-up of the operation is as follows: The scar in the right upper quadrant showed a good hernia repair, no recurrence; fistulous opening was present in the scar. A catheter was passed through this opening and, on opening the abdomen, was found in gall-bladder. Situated in the ampulla and blocking the cystic duct was a large cylindric gall-stone 3 x 1 cm. in diameter. Its proximal end lay flush with the common duct. At the area where the gall-bladder was adherent to the colon the tissue was hard, necessitating a submucous dissection of gall-bladder at its distal half.

Before the operation the incision was discussed in the preoperative note. I consider the reversed L-shaped incision the best in cases of this type, *i. e.*, secondary cholecystectomies, in order to approach the ducts through free peritoneum. That is a surgical principle that is wise to follow in any secondary operation. It is always easier to approach a diseased abdominal viscus in a secondary operation through uninvolved peritoneum than through scar tissue. The exposure afforded by this incision gave us easy access to the ducts. The impacted stone in the cystic duct presented another interesting point. It was a large

cylindric stone, as you see, which impinged upon the common duct. If a clamp had been applied it probably would have slipped off and included a part of the wall of the common duct. To avoid this an incision was made over the ampulla, the stone was drawn out of the cystic duct, and a ligature was then tied over the duct. The cystic vessels were tied separately, as they should be in all cases, and the ligature carrier should be passed out toward the gall-bladder rather than to the midline toward the duct. The gall-bladder was then removed. The common duct was not dilated, no stone was felt in it, and the pancreas was not indurated around it, so it was not opened or drained. A rubber tube was placed down to Morrison's pouch.

Following operation, on the second day, he began to show bile in his dressings. Evidently the ligature had cut through his scarred duct stump. This takes place in a fair percentage of cases. In such cases, there being no clot in the stump and as there is pressure of bile in the common duct, the escape of bile is logical. The drain cares for this and is, therefore, indicated in every cholecystectomy.

He has had two complications of considerable importance and frequency in biliary cases. He vomited frequently for the first forty-eight hours and he had hiccup. The vomiting was controlled by a hot lavage and by what we call "gastric tolerance diet"—very little diet to be sure. The patient is given 1 dram of chloroform-water, freshly prepared, followed in ten minutes by ½ ounce of peptonized milk. This is repeated every hour up to four doses. If vomiting has ceased, the peptonized milk is increased to 1 ounce every hour. After that chloroform-water is stopped and the patient is put on gradually increasing amounts of fluids without milk, *i. e.*, albumen-water, broth and sour milk, prepared with lactic acid bacillus. His hiccup was relieved by letting him take a teaspoonful of chloroform-water whenever he showed a tendency to hiccup. But, understand, a measure that will relieve one patient of hiccup may have no effect on another. Unfortunately, there is no specific for hiccup. Each case has to be treated individually in that regard.

This is now his eleventh day after operation. His tempera-

ture is normal and his biliary discharge is lessening, though still free. The biliary fistula should close in another four or five days.

Case II.—C. M., female, single, age fifty-one. History No. 48,089. Admitted to the Presbyterian Hospital November 16, 1920.

Chief Complaint.—Pain in the right upper quadrant.

Past History.—Rheumatic fever as a child. No history of typhoid. No pregnancies.

Present Illness.—Began one year before admission with symptoms of indigestion. Four months later she had her first attack of right upper quadrant pain with vomiting. The pain was severe and localized. Subsequently she had several similar attacks, sometimes followed by jaundice. She was first seen in the Out-patient Department in September, 1920. Examination then showed tenderness in the right upper quadrant, none in right costovertebral angle. Stomach and urinalysis, fluoroscopic and radiographic studies showed no abnormalities. One month later, in October, she was examined, and right costovertebral angle tenderness and pus in urine were found. Cystoscopy showed turbid urine coming from the right ureter which microscopically showed pus. She was given urotropin, with clearing of her urine.

On November 16, 1920 she came to the hospital in great distress and looking acutely ill. Pain was present in right flank and in right upper quadrant. No radiation. Tenderness was marked over right upper quadrant and a mass could be made out in gall-bladder region. Some tenderness in right costovertebral region. Her skin was slightly jaundiced. There was moderate edema of the ankles. Heart sounds were irregular and muscle sounds of poor quality. Lungs emphysematous.

Temperature, 104° F.; pulse, 120; respiration, 24; W. B. C., 18,000; Polys., 82.

Urinalysis.—Few hyaline casts and scattered W. B. C.; bile present. No glucose.

Duodenal Tube Findings.—Bile and pancreatic ferments present. Culture showed a Bacillus proteus.

She was observed for two days. Her tenderness and mass decreased rapidly in right upper quadrant. Temperature fell to normal. Jaundice persisted. *x*-Rays of kidneys and ureters were negative.

DR. WHIPPLE: What diagnoses do you think were considered?

STUDENT: Common duct stone.

STUDENT: Pyelitis or perinephritic abscess.

DR. WHIPPLE: If it had not been for the previous history of pain in right upper quadrant associated with jaundice, together with persistent though mild jaundice for the two days before operation, the urinary findings and cystoscopic examination in the Out-patient Department, and the costovertebral and right flank tenderness on her physical examination would have favored a kidney lesion, a pyelonephritis with perinephritis, rather than a biliary tract lesion. But the history of attacks of pain in right upper quadrant, pain followed by temporary jaundice, and the tenderness in right upper quadrant with deepening jaundice after admission, made the diagnosis of cholelithiasis, with calculi in gall-bladder and common duct the logical diagnosis. Let me emphasize again the relative value of jaundice as a factor in diagnosis of upper abdominal lesions. Its absence in no sense rules out gall-stone disease. Its presence, especially if intermittent and following right upper quadrant or epigastric pain, is almost pathognomonic of cholecystitis and cholelithiasis. This should be self-evident if you remember that the presence of jaundice is dependent upon the site of the obstruction in the biliary tract. The patient had a leukocytosis, marked tenderness in right upper quadrant, and right rectus spasm. What would that indicate?

STUDENT: Acute infection of the gall-bladder.

DR. WHIPPLE: Unquestionably an acute infection or an exacerbation of an old infection. Do you think the acute infection involved the common duct? Did she have an acute cholangitis?

STUDENT: Probably not. There were no chills and spiking temperature.

DR. WHIPPLE: One would expect more reaction with a cholangitis. In this case we also thought of a pancreatic lymphangitis following an acute cholecystitis. And because of the incomplete common duct obstruction this was considered as probable a diagnosis as common duct stone by two of the staff men.

On account of her age, her emphysema, her weak heart muscle, and her kidney findings she was considered a poor risk. But her repeated attacks of jaundice and her recent acute attack made operative treatment imperative. A general anesthetic was contraindicated. The exploration, the cholecystectomy, and choledochostomy were all done under local novocain anesthesia. The patient co-operated remarkably well.

The gall-bladder showed a very marked chronic inflammation with gall-stones, but not so much evidence of recent acute inflammation as one would expect from her signs and blood count. The common duct contained several pigmented stones. There were three large stones averaging 1 cm. in diameter. Why she did not have more obstruction is difficult to say. The pancreas around the terminal common duct was indurated and thickened, causing some narrowing of the duct.

The patient has done wonderfully well, very much better, I am sure, than if she had had a general anesthetic. Of course, operating under local anesthesia requires more time and effort than under general anesthesia—one hour and forty minutes in this case. But the patient's pulse did not go over 76 at any time during the operation and her subsequent course has been remarkably smooth. She has had no temperature above 100.4° F. Her pulse has not risen above 84, she has had no fibrillation, due probably to digitalis therapy. Now on her fourteenth day she has a firmly healed wound with a small granulating tract at the site of the drain. The biliary fistula closed on the twelfth day.

The interesting features of this case are the facts that although she had so many calculi—three large stones in her common duct—and although she had quite a bit of pancreatic involvement around her common duct, she showed only slight jaundice. Also that the gall-bladder did not show as much

acute inflammation as one would look for. Finally, the advantages of local anesthesia in a patient showing heart, lung, and kidney involvement.

Case III.—Female, married, age forty-four. Admitted to the Presbyterian Hospital October 14, 1920.

Chief Complaint.—Attacks of pain in right upper quadrant.

Present Illness.—For past ten years she has been having irregular attacks of right upper quadrant pain with vomiting. Pain has sudden onset, is colicky, situated in right upper quadrant, lower thorax, and between the shoulders. These attacks have not been associated with fever or jaundice. She has chilly sensations at onset, but no chill. The last attack occurred five days before admission, and has been more or less persistent ever since. There has been much bloating after meals.

Past History.—She has had eight pregnancies. No history of typhoid. Severe bloating and belching for fifteen years. Born in Italy. In United States sixteen years.

Physical Examination on Admission.—A frail, middle-aged, Italian woman in great pain. No jaundice. Temperature, 101° F.; pulse, 108; respiration, 24; W. B. C., 20,000; polys., 82. The abdomen showed a globular mass in right upper quadrant extending 1 cm. below umbilicus, which was tender, hard, very near anterior abdominal wall. There was muscle spasm in right rectus. The mass was movable from side to side, and gave sense of ballottement.

The remaining physical examination was negative except for relaxed perineum and lacerated cervix.

DR. WHIPPLE: This patient presents a very interesting case for analysis. Some of you know about her, for I discussed her case with one of the sections in the conference on common duct obstruction. I shall ask questions of the other section.

Because of the continued severe pain over a period of five days with the failure of the tender mass to subside it was thought wise to explore. I am indebted to Dr. Hanford for permission to present this patient. He had charge of her case and assisted at her first operation and performed the successful operation for

relieving her common duct obstruction. The diagnosis before operation was given as either hydrops of the gall-bladder or acute cholecystitis. What do you think of the diagnosis of hydrops in a patient with that history?

STUDENT: I think that it was made chiefly on account of the movable mass.

DR. WHIPPLE: What in the history, would you say, was against hydrops?

STUDENT: The intermittent attacks would imply a chronic thickening with contraction.

DR. WHIPPLE: If such a movable mass were found in a young woman during or shortly after a pregnancy, hydrops would be more probable as a result of a sterile pure cholesterin stone in an uninflamed gall-bladder. This patient gives a history covering ten years, and that implies a chronic cholecystitis with non-elastic gall-bladder.

The points in favor of acute cholecystitis are: The extremely tender mass, the spasm of the upper right rectus—indicating peritoneal irritation, a pericholecystitis—and her temperature. The operative findings explain the enlarged gall-bladder. Here it is, but much smaller because of the formalin fixative. The walls are markedly thickened as a result of edema, and impacted in the neck is the single translucent pure cholesterin stone. The natural history of the patient's past ten years of gall-bladder trouble is before you in the specimen. This is a pure cholesterin stone, with bile-pigments at both ends, where it was in contact with bile in gall-bladder and cystic duct. Probably until recently this gall-bladder was sterile; the attacks of colic were caused by the stone becoming impinged in the duct and held in the ampulla. But lately, especially in the last attack, to the process of cystic duct obstruction was added the process of inflammation, resulting in the edema and dilatation, and the deposit of calcium-bilirubin salts on the free ends of the stone. I believe from her history and the stone that she did not have her superimposed inflammation until the last attack.

Following her operation the history is exceedingly interesting. She developed a complication which is always very trying

in biliary surgery and not uncommon, *e. g.*, a pneumonitis. It was typical in its onset within forty-eight hours after operation. Temperature dropped by lysis. Mouse sputum inoculation showed a Pneumococcus IV. This is the most common type in postoperative pneumonia. In some hundred cases studied in this hospital in 1914 to 1917 we found the Pneumococcus IV in over 60 per cent. of the sputa.

Shortly after operation, on the third day, bile was noted on her dressings. The scleræ and skin showed jaundice on her fourth day. Stools appeared clay colored on the sixth day. From this time on for three weeks she became progressively jaundiced. A very puzzling feature was that the bile which had been abundant in the dressings stopped flowing on the sixth day and the fistula closed. Duodenal intubation showed a colorless, alkaline duodenal content, with active pancreatic ferments, but no bile. She had no temperature. No chills. Her blood-clotting time rose steadily until before operation it was forty-four minutes.

The operator and the assistants were most emphatic in stating that the operation was uncomplicated. The structures in Callot's triangle—the cystic duct, common duct, and cystic vessels—had been easily visualized. The cystic duct and vessels had been ligated separately. No clamps were used. In every respect accepted technic had been followed. She presented a most difficult problem from the standpoint of explaining the cause of her jaundice and she was carefully studied by several of the attendings. Let me emphasize again that she had had an easy, uncomplicated operation, in which accepted technic was followed, practically eliminating the possibility of common duct injury or ligation. No stones were found in the common duct, she had had a biliary discharge from her wound from the third to the sixth day, when the fistula closed; her jaundice began to appear on the fourth day and continued progressively. If you think over these conditions in the problem you will be forced to one conclusion as to the pathology causing the obstruction. What would you say was the cause?

STUDENT: Pancreatic lymphangitis.

STUDENT: Stone in the duct.

STUDENT: Kink in the duct.

STUDENT: Cholangitis.

STUDENT: Spasm of the sphincteric muscle.

STUDENT: Fibrosis of the duct.

DR. WHIPPLE: The most common causes of common duct obstruction following operation are: first, stone overlooked; second, clamping or tying off the duct with resulting stricture. As regards stone in this case, the finding of a single cholesterin stone in the gall-bladder, with normal, undilated, common duct would almost surely rule it out. The observations of the operator and assistants were very much against stricture. But the one feature of the case which ruled out any cause below the cystic duct was the fact that for three days there was a biliary discharge. Any complete obstruction below the cystic duct would have caused a persistent biliary fistula. The process, whatever it was, had to involve the cystic duct level of the common duct, and must have involved that level subsequent to the establishment of the biliary fistula.

The operation revealed a very remarkable condition and one none of us has been able to explain. I assisted Dr. Hanford and am giving you the facts. A cicatrization of the entire common duct from the level of the papilla to a point at the junction of the hepatics—right and left—was found in the form of a band of scar tissue without lumen. What caused this we do not know. The fact remained and necessitated a radical means of re-establishing a channel for bile to reach the duodenum. To accomplish this a rubber tube was placed in an opening at the bulging junction of the two hepatic ducts and the other end was placed into an inverted opening of the second portion of the duodenum. Around this tube a peritoneal reflexion from the round ligament was sutured to the margin of the gastrohepatic omentum. In the process of dissecting the cicatrized common duct to try to find a lumen the portal vein was incised, but was successfully sutured with fine silk.

The patient stood the operation remarkably well. She had been given an intravenous infusion of 0.2 of 1 per cent. of cal-

cium lactate, 300 c.c., before operation and had no oozing during or after operation. It is now twenty-three days since her operation. Her jaundice has cleared, she is having normally colored stools, her appetite is good. She is walking. She has no biliary fistula and has had none since the last operation. It is too soon entirely to call her cured. A year from now, if she passes the tube and is free from symptoms, we may consider her cured. Too many of these cases of common duct reconstruction are reported as cured within a month or two, and go down in the literature as such. The failures, even if subsequently reported, are not linked up with the previous premature reports.

CASE FOR OPERATION

Case IV.—M. H., female, fifty-two.

Chief Complaint.—Epigastric pain. Jaundice.

Present History.—Dates back two years, when she began to have severe epigastric distress, with bloating and belching after meals. At intervals of ten days to two weeks she would have severe tearing pain in the epigastrium. Six months before admission, after a severe attack of pain, she became markedly jaundiced for a period of four to five days. The jaundice cleared, but the distress persisted.

Three weeks before admission she had a severe attack of cramplike pain in the epigastrium, radiating around the costal margin, and focusing in the right scapular region. During the attack she had severe vomiting and tenderness in the right upper quadrant and epigastrium. A week later she developed jaundice, which has persisted, increasing in intensity, up to the time of admission. Pruritus has become very annoying.

Past History.—She had always been well up to two years ago. No history of typhoid. She has had sixteen pregnancies.

Physical Examination.—She is a well-nourished middle-aged woman. Skin deeply jaundiced. Temperature, 99° F.; pulse, 112; respiration, 24; W. B. C., 11,000; polys., 90. Heart and lungs negative.

The abdomen showed marked tenderness in the epigastrium.

Liver edge could be made out 3 cm. below the costal margin, and was tender. No muscular rigidity.

The Wassermann was negative. Blood cholesterin 2.3 per cent. Blood coagulation time thirteen minutes. Examination of the stool showed absence of bile. Duodenal intubation showed an alkaline, colorless, slightly viscid fluid, containing no bile. There was no response to $MgSo_4$ instillation. Culture of duodenal fluid showed a Staphylococcus albus and a Gram-positive bacillus—probably mouth contaminations.

DR. WHIPPLE: This patient presents as typical a history and physical findings as is possible for a clinic on surgery of the biliary tract. Her many pregnancies connoting a high cholesterinemia, the history of the past two years, her present history and physical findings and laboratory tests all point to a chronic cholecystitis with calculi in gall-bladder and common duct, probably also an associated pancreatic lymphangitis.

She has been under observation in the hospital for five days and because of persistent jaundice and absence of bile in the duodenum and threatening cholangitis she is to be operated upon.

The incision to be used is determined, first, by the type of operation intended, *i. e.*, as to whether or not the common duct is to be attacked, as in this case; and second, by the arc of the intercostal angle. For patients with a wide arch or intercostal angle, or in cases with flaring ribs, as in the old emphysematous male, the transverse or obliquely transverse incision gives the best exposure. Where the intercostal angle is narrow the vertical or hockey-stick incision gives an easier access to the gall-bladder, facilitating the rotation and exposure of the right lobe. A free exposure is essential in biliary tract operations; it saves time, insures access to a difficult and dangerous zone, and prevents blind work. In this patient, both because of the wide intercostal angle and the common duct obstruction, a generous oblique incision is used.

Hemostasis in jaundiced cases should be most carefully carried out; even the smallest bleeding points should be ligated. This precaution together with preoperative intravenous infusion

of a 0.2 per cent. calcium lactate solution will prevent the distressing and sometimes fatal oozing after operation.

In cutting through or across the rectus muscle the vessels should be clamped before cutting to avoid retraction of the bleeding vessel into the muscle.

The liver is now visible. After separating the numerous adhesions between colon, duodenum, and under surface of the

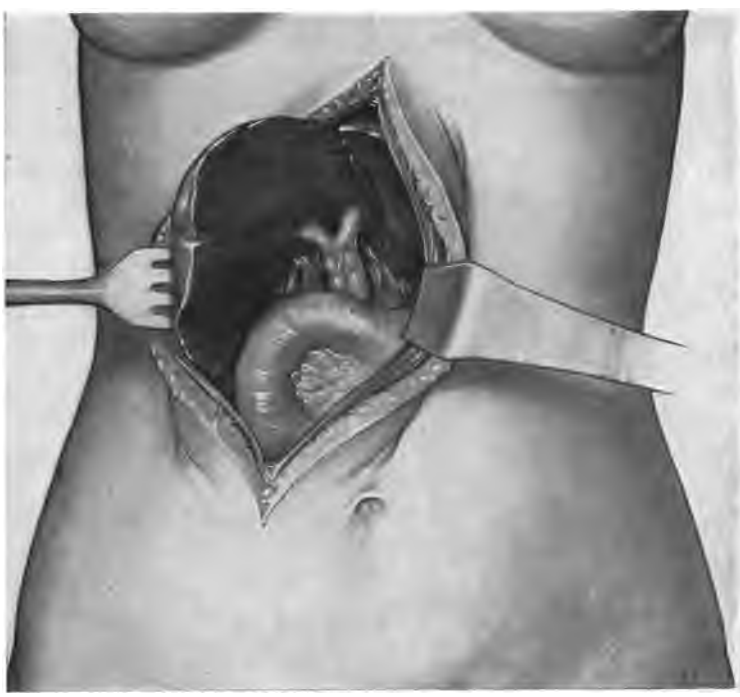

Fig. 147.—Sketch of the patient with common duct stones, without any evidence of cystic duct or gall-bladder.

liver we find a very unusual condition. There is no bed in the under surface of the liver for a gall-bladder. What I took to be gall-bladder is a markedly dilated common duct containing several large gall-stones (Fig. 147). The vessels run transversely rather than in the long axis of the mass. There is no evidence of a cystic duct either inside or outside the common duct. On

opening into this structure these four large stones are found. They are dark brown in color, soft, crumble easily, rounded, non-facetted, that is, typical bile-pigment stones. The finger passes up easily to a bifurcation, one branch passing to the left, the other to the right, evidently the hepatic ducts. In passing down the duct obstruction is met at or near the papilla, but no gritty feel is elicited with the gall-stone forceps, and the obstruction corresponds to the thickened pancreas about the terminal end of the duct, *i. e.*, a moderate pancreatic lymphangitis.

In a case like this it has been my experience that if no grating feel is made out on gently probing with a blunt metal instrument it is wiser not to try to force a passage into the duodenum. If the common duct is properly drained, that is, for two to three weeks, the pancreatic swelling subsides and the lumen of the common duct is re-established.

In this case either the gall-bladder is a deeply placed intrahepatic one with a cystic duct communicating with one of the hepatic ducts or there is a congenital absence of the gall-bladder. Because of the absence of the cystic duct and vessels and because of the atypical arrangement of the right lobe and the Spigelian lobe I believe this is a case of congenital absence of the gall-bladder. This is the third case I have seen. In the first case I remember, an operation in which I assisted Dr. Peck, there was a congenital absence of the left lobe as well as of the gall-bladder.

We have sutured a rubber tube drain into the common duct, using plain gut. This drain will also be sutured into the skin to keep it in place for two to three weeks. I believe in prolonged common duct drainage in cases of pancreatic involvement. Another rubber tube drain is placed in Morrison's pouch to avoid a subhepatic collection of blood and bile, with possible later abscess formation.

In the closure it is essential to suture carefully the peritoneum and transversalis fascia or posterior rectus sheath. I use a locked stitch of continuous plain gut. Formerly I used mattress sutures in the cut ends of the cut rectus. This was an error, for the tension of the sutures caused necrosis of the muscle, everted the

ends of the muscle, and favored a wide band of scar tissue. Now I use interrupted chromic sutures to bring the severed ends of the anterior rectus sheath into accurate approximation. No attempt is made to suture the cut ends of the rectus muscle. The scar in the skin of the transverse incision is certainly less noticeable than in the vertical incision. This is very evident in our follow-up cases.

CLINIC OF DR. FRED H. ALBEE

POST-GRADUATE HOSPITAL

PLASTIC SURGERY OF THE HIP AND FEMUR

Case I.—W. W., aged five, while riding in a small wagon on the sidewalk, June 4, 1915, was accidentally overturned by an automobile backing out of a driveway, and his right femur was fractured at the junction of the upper and middle third. The leg was placed in a plaster-of-Paris cast, including hip and ankle; traction, by means of adhesive straps below the fracture and brought out through the sides of the cast, was applied and continued after the patient was transferred to bed.

Fig. 148.

On account of the apparent impossibility of keeping the ends of the fragments together (Fig. 148) an open operation was done on July 15, 1915. A fair-sized callus had formed about the bone ends, but had not bridged the gap because there was muscle to the thickness of $\frac{1}{2}$ inch lying between the ends of the bone. A sharp superior fragment was displaced forward, overlapping about 1 inch.

Studying the subsequent history of this case, it is believed that this surgical tragedy had its inception at this very juncture, because the methods used were not competent to remove the interposed muscle from between the fractured ends during the critical period in the union of the fractured bone. In other words,

the callus was prevented from bridging the gap from one fractured fragment to the other during the first few weeks following the fracture, which is the most active osteogenetic period. The traction had overcome the shortening to a degree which would have hardly passed, but if union had taken place the limb would undoubtedly have been satisfactory for function. The muscle between the bone ends, however, prevented union. This frequent state of affairs can be prevented in a large percentage of cases only by early open operation, excluding the displaced muscle and bringing together the fractured ends. Naturally, this is not possible of accomplishment by purely tractional methods, neither of the skeletal type nor by the adhesive plaster used in this case. By the skeletal type of traction is meant thc Steinmann or Codivilla nail and the different types of tongs and stirrups.

It is believed that experiences in military surgery have often led to misunderstandings when the lessons there learned have been applied to civil practice. In France the large percentage of cases seen were not at all applicable to plaster-of-Paris or coaptation splints of any kind, and could be controlled only by traction applied at a distance from the extensively lacerated compound fractures in a position of neutral muscle pull, most effectively brought about by means of the development of the Balkan frame. By this means results were obtained which, while not ideal as compared with the results so frequently attained with simple fractures in civil practice, were nevertheless the best that could be secured under the circumstances and were functionally satisfactory in a large percentage of the cases. In civil practice, however, the problem is entirely different. A large majority of the fractures are of a comparatively simple type and more perfect results are demanded. If the closed method does not produce satisfactory results as measured by these higher standards, then a prompt decision should be made within the first few weeks following the fracture, and an open operation should be done, bringing the ends into close coaptation, and so holding them by the simplest procedure possible, using an absorbable material, such as kangaroo tendon.

When done properly it is believed that this is the most ideal method, in that the insertion of a non-absorbable foreign body with all its tissue-destroying properties is avoided, and, moreover, that the kangaroo tendon ligature does not interfere with the mechanical end-to-end thrust of one fragment upon the other, this being nature's most potent influence to promote active callous formation. In fact, the influence of mechanical stress of all kinds in promoting active osteogenesis cannot be overesti-

Fig. 149.

mated. The lessons of the Balkan frame have proved still further the value of "posture of neutral muscle pull," and this must be made the most of in applying the external splint of plaster of Paris. Traction should never be applied if it can possibly be avoided when the fragments are secured end to end.

Operation (July 15, 1915): Two bone fragments were removed, perfect coaptation was secured, and approximation was obtained by a 3-inch Lane plate on the inner side and a 2-inch plate on the outer side. (Figure 149, which is a skiagram made

August 10, 1915. The screws have already loosened and are falling out of the bone. The fragments are in marked malalinement.) Following this operation the patient ran an uneventful clinical course, with temperature of 100° F. at the end of twenty-four hours, 99.6° F. at the end of forty-eight hours, and normal thereafter. When the cast was removed on August 22d the child was taken home to be cared for by his mother, who

Fig. 150.

was a graduate nurse. Various observations were made. One month after the operation there was a large callus thrown out on both sides, with softening of the bone around the screws. On September 22d the Lane plates were removed from the right femur. The bone was seen to be apparently firmly united and slightly curved forward at the site of the fracture. A discharging sinus was dissected out and iodoform gauze introduced. The wound was closed with silkworm-gut sutures, and the leg put

up in splints. The wound was completely healed on October 8th, when the boy was allowed to begin walking.

On December 1, 1915 it was evident that the femur was bent, and an *x*-ray examination made at this time showed that the bone was bowing considerably and that bony union had not been secured (Fig. 150).

This case, one of a very large number that have come under the care of the writer, proves conclusively that internal metal agents of all kinds cannot be trusted to hold fractured bone fragments in alinement. If lateral stress constantly comes upon the long Lane plate or the intermedullary ivory or metal cylinder, the bone at the point of pressure around the screw holes or at the end of the splint will melt away and the fixation will thus be lost, as shown in Fig. 150. There may be a difference of opinion as to why this fracture did not unite, but there is no question that the following etiologic factors had something to do with it: (1) the large amount of metal used and the consequent amount of bone destroyed due to inhibition of callous formation; (2) the interference with the end thrust of the fractured fragments during the most active osteogenetic period.

There may be a discussion as to the *modus operandi* of the Lane plate as an etiologic factor in producing non-union, but it will still remain true that in the writer's experience the metal plate comes first as the cause of this crippling condition. Apropos of this, it is believed that the very perfection of the fracture table—such as the Albee or Hawley tables—may, when improperly used, contribute to the etiology of non-union, in that the screws of the Lane plates are inserted while the fragments are held with a gap between their fractured ends. In this way the fractured ends are thus prevented from coming together until the destructive action of the metal screws, pushing against the bone, has destroyed it to a degree that the plate is loosened and the bone ends do not come together until the active osteogenetic period has passed.

Again, in this particular case, another fundamental principle was violated by removing the two fragments from the site of the fracture.

These fragments were attached to the muscle, and if left in place would undoubtedly have aided in furnishing callous formation. One cannot say whether or not they would have furnished sufficient osteogenesis to have turned the tide toward union. It is clear, however, that it was a mistake to remove them.

On February 20, 1916 an autoplastic sliding bone-grafting operation was done. For some reason the house surgeon had what seemed to be a religious scruple against the use of plaster of Paris. At no time since the treatment had begun on this leg had plaster of Paris been employed, and none was used at this time. A record in the notes made by the house surgeon states that on the second or third day, while the patient's leg was out of the removable splint for dressing, his activity in moving himself undoubtedly twisted the fragments in relation to each other and broke the sutures holding the graft in place.

One cannot condemn too strongly the fact that the surgeon entrusted a most important part of the surgical procedure to the house surgeon, namely, the application of the postoperative fixation. Only one individual should do this work—the operating surgeon himself. This part of the work taxes the full experience of the bone surgeon. It involves not only a carefully molded and applied plaster of Paris, but the question of the "posture of neutral muscle pull." This must be determined by careful study in each individual case. Furthermore, the attitude of the house surgeon in relation to plaster of Paris was entirely wrong. The writer has seen many cases in which it was certain that the failure from an operation of this nature was due to inadequate postoperative fixation. In one prominent case the sole postoperative fixation was the adjustment of the limb in a Balkan frame. The postoperative fixation cannot be too perfect. Absorbable sutures should always be used in the skin, and no windows should be made in the plaster for the purpose of their removal. It is not the window in the cast nor the removal of the suture that does the harm, however; it is the loosening of the splint by the removal of the dressing and the cotton packing overlying the wound.

On March 25, 1916 an *x*-ray examination showed no evidence

of bony union. A considerable bowing of the leg began to occur.

On April 12, 1916 the bone-grafts were removed and drainage was instituted.

On May 2d the patient was first seen by the writer in a western city. At this time the bone ends were displaced and overriding about 2½ inches. The leg was severely infected and the wound was discharging a large amount of seropurulent material. The soft parts were separated from the ends of the fragments for a distance of about 2 inches, and the ends of bone were lying in a pool of pus.

Despite the state of infection, it was decided that in order to prevent permanent shortening and also to make conditions more favorable for overcoming the infection it was necessary to immediately enlarge the opening, place the bones end to end, and hold them in position with phosphor-bronze wire. This agent was chosen because it was feared that in the presence of an infection the kangaroo tendon would become absorbed too early. The ends of the bones were morticed in a V-shaped fashion with Albee's motor saw, so that there would not be a tendency for them to become displaced if necrosis took place and the wire cut through the bone.

This is a very important point in the technic of such a procedure, and it cannot be too strongly emphasized, namely, the morticing of the bone ends in such a way that the bone morticing takes the stress, and one does not need to trust entirely to the treacherous hold of any internal fixation agent, whether the Lane plate, metallic wire, or kangaroo tendon.

The wound was packed with iodoform gauze down to the junction of the two ends, and a long plaster-of-Paris spica with a large fenestrum over the wound was applied, reaching from the base of the toes to the costal margin, the leg being in about 20 degrees of flexion and the limits of physiologic abduction. After some weeks the phosphor-bronze wire came out. The wound drained for a long period, and finally healed in November, 1916. The femur remained ununited, and on September 21, 1917, at the New York Post-Graduate Hospital, the writer did

an inlay graft operation from the tibia (for the technic of which the reader is referred to Albee's Orthopedic and Reconstruction Surgery, page 572). Skiagrams taken October, 1920, demonstrate very splendid results obtained (Fig. 151). The graft has become thoroughly amalgamated and the femoral shaft is fully restored except for about $1\frac{1}{2}$ inch shortening. The function is

Fig. 151.—A very excellent result in a difficult pseudarthrosis of the right femur is shown. The graft has become so well amalgamated that it is difficult to determine where it was inserted.

excellent and considering the very difficult nature of the case it is very gratifying.

Case II.—A. M., a prominent actress and dancer, twenty-seven years of age, fell on February 2, 1919, and sustained a fracture of the central portion of the neck of the right femur. On February 3d she was taken to the French Hospital and the fracture was reduced under an anesthetic and a long plaster-of-Paris spica was applied from the base of the toes to the costal

margin, with the limb in marked abduction. The patient remained in bed until the plaster-of-Paris spica was removed on April 6, 1919. After that she walked with the aid of crutches, bearing weight on the fractured limb until the early part of May, 1919. Then she used one crutch until the last part of May. She received massage of the thigh and hip from the last part of May until the last part of July, and was advised to use the limb all she could.

On September 22, 1919 she consulted the writer, and at that time complained that weight bearing of all degrees was painful, that the limb felt weak, and that it was never comfortable to walk. In fact, she complained of pain all the time, night and day, exaggerated by standing or walking. When lying down the hip seemed to drop backward.

On examination patient walked with a limp of pain and weakness. When placed on the examining table in the dorsal position and the right thigh and knee flexed, a loose non-union at the hip was demonstrated by the examinner in this way. His left hand was placed on the patient's hip with the thumb on the anterior superior spine of the ilium, while the tips of the fingers were placed upon the great trochanter, traction upon the femur demonstrates a very free false point of motion at the hip, which was associated with pain. With the limbs fully extended the distance between the right anterior superior spine of the ilium and the right internal malleolus was $32\frac{3}{4}$ inches; while on the left side it was $33\frac{1}{4}$, demonstrating $\frac{1}{2}$-inch shortening. When the right foot was forcibly pulled upon, the same measurements showed a shortening of only $\frac{1}{4}$ inch; and when the right foot was forcibly pushed upon the shortening was increased to $\frac{3}{4}$ inch. This test demonstrated conclusively that there was no union at the point of fracture, and force applied first by pulling and then by pushing brought about a difference of $\frac{1}{2}$ inch in the length of the limb.

The motions at the hip were considerably limited in all directions by much spasm and were associated with pain.

An *x*-ray taken at this time showed an ununited fracture of the neck of the right femur (Fig. 152).

The Wassermann test was negative.

The writer's bone-graft peg operation was recommended, but the patient did not decide to have the operation until two months later.

Operation, December 2, 1919, ether.

Bone-peg graft operation. Patient in dorsal position on Albee fracture-orthopedic table. Feet covered by several thicknesses of plaster cotton and bound firmly into traction footpieces. Extensive fields of operation in regions of right hip and right lower leg were prepared by a generous coating of 3.5 per

Fig. 152.

cent. tincture of iodin. The point of fracture was reached by an incision 5 inches in length, along the outer border of the sartorius muscle, reaching from the anterior superior spine of the ilium downward. The anterior portion of the capsule of the hip was reached by blunt dissection between the muscles. The hip-joint was entered by a T-shaped incision (Fig. 153, *a*, *b*). Fragments of the neck of the femur were found loose, with no attempt at union whatever. The fractured ends were covered with connective tissue and a reduplication of synovial membrane. The end of a pair of blunt scissors was readily placed between the

fragments, and by pushing with the end of the scissors on the fractured surface of the head fragment with some force it rotated freely. It was accordingly decided to insert a tibial bone-graft peg. If a failure to get the head to rotate had occurred the removal of the head with its placement of the trochanter in the acetabulum would have been done.

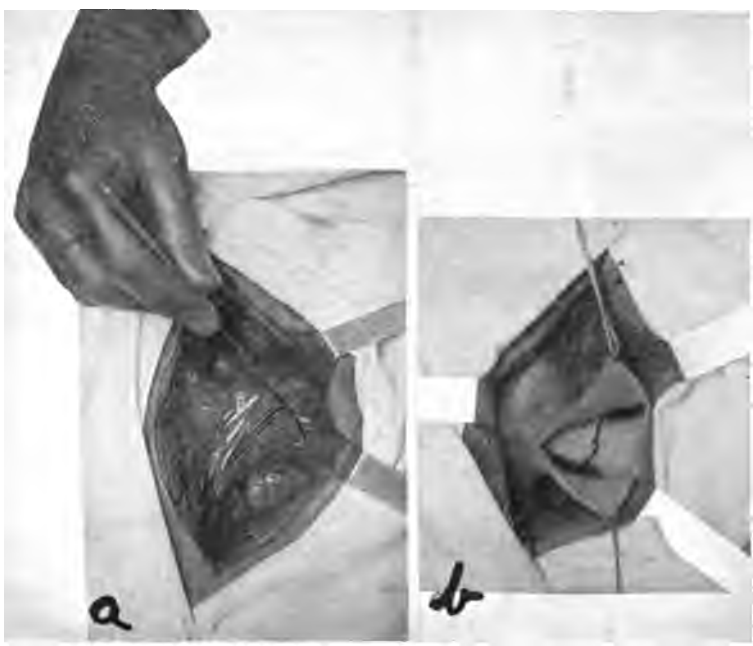

Fig. 153.

The table was so adjusted that the distal fragment of the femur was rotated slightly outward, laying bare its fractured surface so that it could be thoroughly denuded and freshened by means of osteotome and mallet (Fig. 154). The fractured surface of the head fragment was denuded in the same way.

This feature of the operation is important and should be done thoroughly, for the reason that dense connective tissue and sometimes portions of the joint capsule may be found lying in between the fractured fragments.

The next step was to determine the proper alinement of the fragments. This was accomplished by rotating the limb back with the foot directed upward and applying sufficient traction by means of the traction screw to pull the distal fragment down in alinement with the capsule fragment. The limb was then placed in about 30 degrees of abduction.

It has been found unwise to place the limb in too much abduction in old cases of non-union, because when removing the cast the weight of the limb brings in lateral stress upon the graft and there is danger of fracture, unless the cast is kept on for a very long period of time.

By means of the above-mentioned adjustments with the fracture table the fragments were brought into excellent ap-

Fig. 154.

position. In cases of a considerable amount of shortening it is not always wise to attempt to pull the distal fragment down so that the fragments will come into perfect end-to-end approximation, because of too much postoperative strain upon the graft. In this particular instance, however, the hip was so loose that there was no difficulty in this respect.

The wound was then temporarily packed with a hot saline compress, and the great trochanter was reached by a lateral incision directly over it, about 4 inches in length. The insertion of the vastus externus fascia at the outer surface of the great trochanter (Fig. 155, *b*) was developed, and an incision parallel with the shaft of the femur was made from this insertion down-

ward for 1 inch, splitting the fibers of both the fascia and the underlying vastus externus muscle. Through this cut the point of the Albee hip drill was placed upon the outer surface of the trochanter about ½ inch down from the border of this fascial insertion (Fig. 155). The electric power was then turned on, and the drill allowed to enter the bone for from ⅓ to ½ inch. The packing of the anterior wound was then removed and the proper direction of the drill was carefully estimated by means of bearings taken from the bony anatomy, observed through both wounds.

Fig. 155.

Roughly speaking, the drill should have a direction of 130 degrees with the long axis of the femur and 12 degrees posteriorly to the lateral axis of the knee-joint.

The drill was then allowed to travel through the distal fragment until it came in contact with a small ribbon retractor which had been placed through the anterior wound and between the fractured fragments. The distance the drill had traveled was then obtained by reading the centimeter markings on the shaft of the drill at the edge of the hole of entrance in the trochanter (Fig. 156, *a*).

A study of a recent anteroposterior *x*-ray plate was then made from an illuminating box standing in direct view during the course of the operation. The reading of the drill was 5 cm., showing that this was the distance from the outer surface of the trochanter to the fractured surface of the distal fragment of the hip-joint. Further studies of the *x*-ray plate showed that the distance that the drill should penetrate the capital fragment should be half of this distance, or 2.5 cm. The ribbon retractor was then removed, and the drill was allowed to travel into the capital fragment until the reading on the drill shaft at the edge of the trochanter drill hole was 7.5 cm. This brought the drill point within about $\frac{1}{2}$ cm. of the hyaline cartilage on the head of

Fig. 156.

the femur. The motor was then disengaged from the drill, which was left *in situ* in the drill hole for the purpose of preventing dislodgment of the bone fragments while the dowel was being shaped. Both wounds were loosely packed with saline compresses.

The field of operation was then changed to the leg. The crest of the tibia was palpated and it was determined that the crest was straightest at about the junction of the middle and the upper thirds. This portion of the crest of the tibia was then laid bare by means of a curved skin incision in the skin and blunt dissection of muscle and soft parts. The proposed graft was then outlined with the point of a scalpel on the periosteum. This

should be done with care so as to obtain a graft of such a size that it will be necessary for the dowel shaper to remove only a minimum amount of bone in order to get a perfect dowel. In order to accomplish this the saw cuts must be made in the planes shown in this diagram (Fig. 157).

The graft was then cut 7.5 cm. long, with the Albee cross-cut motor saw, and was dislodged from the tibia with gentle taps of the osteotome and mallet. The lower end of the tibial graft was chosen for the inner end because of its thicker cortex. The upper end of the graft was then grasped by two heavy Ochsner clamps brought to a conical shape by inserting it in the Albee dowel "pencil sharpener" cutter, held on a small instrument table by an assistant, after which it was passed through the dowel-cutter itself, salt solution being dripped on both graft and cutter during this procedure. The drill was then removed from the neck of the femur and the bone-graft dowel was driven into place with gentle taps from a small mallet, the procedure being completed with the aid of the Albee bone-set, in precisely the same way that the cabinet maker drives home a nail in joiner work (Fig. 158).

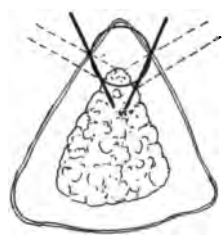

Fig. 157.

Several fragments of bone from $\frac{1}{4}$ to $\frac{1}{3}$ inch long—consisting of the full thickness of bone cortex with marrow substance on one side and periosteum on the other—were obtained from the side of the upper end of the gutter wall in the tibia. This portion of the tibia was chosen because of the thinness of the cortex. These fragments were placed around the dowel graft and between the fractured ends of the femoral fragments (Fig. 159, *c*).

This diagram represents the writer's bone-graft peg in place in the femoral neck fragments. The fit is as accurate as power-driven automatic tools can bring about. The snugness of fit should be as near that of a glass stopper in a bottle as possible. The graft should not be driven in under compression, as this would cause an occlusion of the blood-vessels in the cancellous bone surrounding the graft and thus interfere with the very vital nourishment of the graft; *a* represents the ideal cross-section of

Fig. 158.

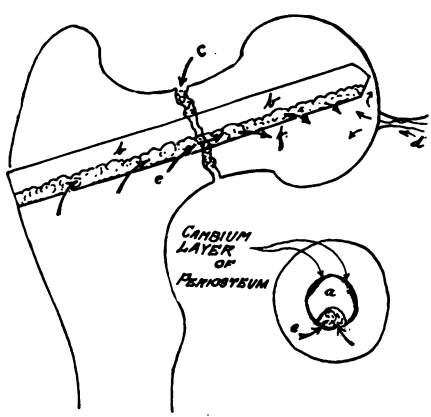

Fig. 159.

a graft in the neck of the femur. The arrow *e* indicates the direction of establishment of blood-vessels from surrounding cancellous bone to marrow substance of the graft. Arrow *d* indicates direction of blood-supply to head fragment from ligamentum teres, of direction of blood coming by way of marrow substance of graft from cancellous bone of trochanter to point of union between graft and head fragment.

Artificial impaction of both these fragments and the femoral fragments was then brought about by placing the end of the handle of a large wooden mallet against the outer surface of the great trochanter, just below the end of the dowel and striking the head of the mallet with the palmar surface of the hand.

Fig. 160.

The hip-joint capsule was then approximated with three interrupted sutures of fine kangaroo tendon. The wound was closed with chromic catgut No. 1 in the fascia, and plain catgut in the skin. The skin suture holes were puddled with 3.5 per cent. tincture of iodin, the excess fluid being wiped away. The skin wounds were covered with a large dressing of gauze and sterile absorbent cotton. The limb was covered with plaster cotton, and a plaster-of-Paris spica, well molded over the bony prominences, was applied from the base of the toes to just below the costal margin on the right and above the costal margin on the left.

The plaster was allowed to remain on for eight weeks. A skiagram (Fig. 160) was taken immediately after the removal of the cast. Although everything seemed to be entirely satisfactory, it was deemed wise not to run any risk of breaking the graft, and a small brace made of light metal and leather was applied over the pelvis and extending down to just above the

knee-joint. The patient was then allowed to go about with crutches, without bearing any weight upon the operated limb. Other *x*-ray plates were taken at periods of one month which showed very satisfactory proliferation of graft and consolidation with strong union (Fig. 161). Four months after the operation the patient was allowed to begin bearing weight upon the leg. Massage to hip and knee was instituted as soon as the plaster cast was removed. The convalescence of the patient has been most gratifying, and eight months after the operation she states that she can walk and dance as well as ever.

Fig. 161.

This case is only one of many in which similar results have been obtained, and it is a striking demonstration of the fact that these conditions respond gratifyingly to proper treatment, despite the oft-repeated statements to these unfortunates that their condition is hopeless.

Case III.—L. C. G., sixty years of age, came under observation December 16, 1916 with a history of having fallen from the third step of the cellar stairs backward on to the cemented cellar floor, striking on the left hip, and was unable to stand immediately following the fall. The patient was anesthetized and the

fracture was reduced within half an hour, and the limb was immobilized with wooden splints. Forty-eight hours later the patient was taken to the hospital in an ambulance, and *x*-ray plates were taken, and the patient was told she had a fracture of the hip. The wooden splints were removed and sand-bags were placed on either side of the limb from the axilla to the foot and from the groin to the toes, this being continued for a period of five weeks. At the end of this time another *x*-ray was taken and the patient was told that the appearance of the plate indicated that perfect union had taken place. She was then encouraged to walk and bear as much weight on the limb as she

Fig. 162.

could. This produced pain, which was described by the patient as great agony. In June, 1916 a short celluloid spica was applied for a period of three months. During this period she walked with crutches and an elevated shoe on the normal side. Following this crutches were used and only a small amount of weight was borne on the fractured limb.

An *x*-ray examination made on December 19, 1916 showed non-union of an intracapsular fracture of the neck of the femur, with almost complete loss of the neck from erosion (Fig. 162).

Operation, December 21, 1916.—Because of the extreme amount of loss of bone at the neck and the added *x*-ray observation that the

femoral head was a mere shell, it was decided to remove the head and to place the neck and denuded trochanter in the acetabulum, a procedure devised by the writer and previously employed most successfully. The hip-joint was reached by the Sprengel or Smith-Pedersen approach. In fact, it is the practice of the writer to use this approach for all operations on the hip-joint. The anterior incision is used only when inserting the bone-peg graft for fracture of the neck of the femur. An incision was made along the iliac crest from the anterior superior spine posteriorly for about 4½ inches. This incision was then carried downward from the anterior superior spine of the ilium for about 4 inches. The fascia lata was then severed about ½ inch below and parallel with the crest of the ilium. Subperiosteally the gluteus medius, minimus, and tensor vagina femoris were separated and carried downward at the same time that the hip-joint was approached through the muscle planes by blunt dissection by way of the anterior incision. The anterior and superior portion of the hip-joint capsule was developed, and a T-shaped incision was made exposing the femoral head and the neck.

The *x*-ray findings were confirmed. The head was a mere shell and the neck was much shortened. The head was removed. The corner of the end of the neck was then trimmed away and the trochanter was incised with the osteotome, as shown on the diagram (Fig. 163, *C*). The limb was then pulled down with the traction screw on the fracture table until it was possible to push the neck and molded upper portion of the trochanter into the acetabulum. The table was then adjusted so that the limb was in an extreme degree of abduction. This posture not only held the trochanter bone lever in the desirable degree of obliquity with the shaft of the femur (Fig. 164, *E*), but held the neck and molded trochanter in the acetabulum with great firmness. The trochanter bone lever was then held forward by interrupted sutures of medium kangaroo tendon. The fascia was closed with continuous sutures of No. 1 chromic catgut; the skin, with No. 1 plain catgut. A plaster-of-Paris spica was then applied from the base of the toes to just below the costal margin on the left, and 2 inches above the costal margin on the right side. This

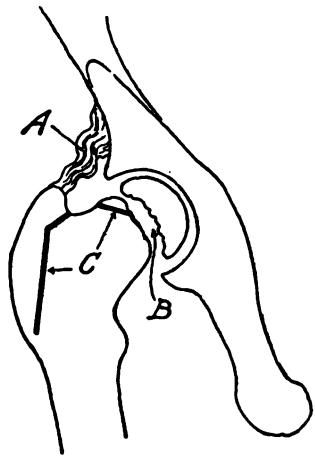

Fig. 163.—The upper end of the trochanter fragment formed by the outer portion of the bone incision (*C*) is forced outward by a strong instrument, producing a greenstick fracture as shown in Fig. 164, 1, at *C*.

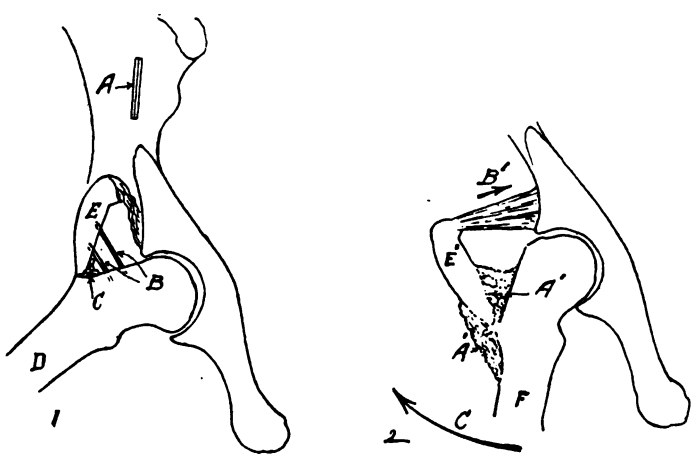

Fig. 164.—1. *D* represents femur abducted; *E*, trochanter lever held in its present position by abduction of the femur; *B* are sliver grafts obtained from the side of the ilium at *A* for the purpose of hastening callus formation at *A*. 2. *F* represents femur brought down in position of right angle to pelvis. The direction of the trochanter lever arm *E'* is as shown since bony union at *A'* has taken place. Under these conditions the muscles at *B'* act as abductors of the thigh, at the same time that they and the surrounding soft parts prevent dislocation of the trochanter from the acetabulum in that they become tense at *B'* as the limb is swung into adduction, the only posture in which a dislocation of the trochanter from the acetabulum is likely to occur.

cast was kept on for a period of seven weeks, after which the patient was allowed to walk with crutches and bear weight. In two months the patient was using a cane and bearing full weight on the limb. In ten weeks full weight bearing caused no pain, and motion in flexion and extension was within 10 per cent. of normal; abduction, within 20 per cent. of normal. All pain had ceased, and the patient stated that when walking and bearing full weight upon the limb the hip again had a feeling of firmness and stability.

Figure 165 is a skiagram made six months after the operation. It shows the end of the neck well within the acetabulum and the

Fig. 165.

trochanter lever firmly united in the oblique position to the shaft of the femur.

Case IV.—Tuberculous Osteitis of the Hip.—Miss M. L., age forty-three, consulted me in May, 1910, presenting every symptom and sign of tubercular hip disease on the right side. The stiffness and pain had come on gradually, beginning in 1908, the pain radiating from the hip down the thigh to the knee. The patient had lost 20 pounds in weight, and was rather pale. She had been treated for rheumatism of the knee.

On physical examination, the patient walked with a right-

sided limp of pain and stiffness. There was no actual shortening. When measurements were taken from the umbilicus to the internal malleoli there was ½ inch of practical shortening. The circumference of the right calf was ½ inch less than that of the left; the circumference of the right thigh was ¾ inch less than that of the left. All motions of the hip were much limited by muscle spasms, and all attempts at passive motion elicited severe spasms and pain. The limb was somewhat adducted and rotated outward.

An *x*-ray examination demonstrated much rarefaction of the head of the femur and some destruction of the acetabulum just under the cartilage; in other words, it confirmed the clinical diagnosis of tuberculosis.

Treatment.—A Phelps hip brace with a 2-inch cork extension on the left shoe and crutches were prescribed, also a régime of life suitable for a tuberculous patient, namely, general rest, fresh air, and forced feeding.

For two years the patient wore the brace, with crutches, and religiously observed the treatment advised. The results, however, were so far from satisfactory that it was decided to surgically immobilize the diseased hip. In view of the fact that a tuberculous lesion existed in the hip-joint it was not thought wise, if it could be avoided, to enter this infected region, and it was therefore decided to bring about a bony ankylosis by means of a truss work of two bone-grafts extending from the great trochanter to the side of the ilium, 2 inches above the hip-joint, as shown in diagram (Fig. 166).

Operation.—A curved incision about 6 inches in length, with its convexity forward, was made with its lower end over the trochanter extending upward over the gluteal muscles. The outer surfaces of these muscles were laid bare and two incisions were made in them in the shape of a V, converging at the trochanter, with the upper ends about 3 inches apart at the ilium. With the Albee motor saw two cuts in the form of a V with its apex downward were made for a depth of about ½ inch in the outer surface of the trochanter. Trap-door flaps, consisting of a portion of the trochanter and the overlying sound parts, were

then turned upward and downward, leaving between them the V-shaped island of the trochanter intact and undisturbed. The outward surface of the wing of the ilium at the upper ends of the cuts in the gluteal muscles was then laid bare by blunt dissection. Mortices ½ inch in width were then made through the outer table of the ilium by means of a long osteotome, which was placed during this procedure with its cutting surface against the

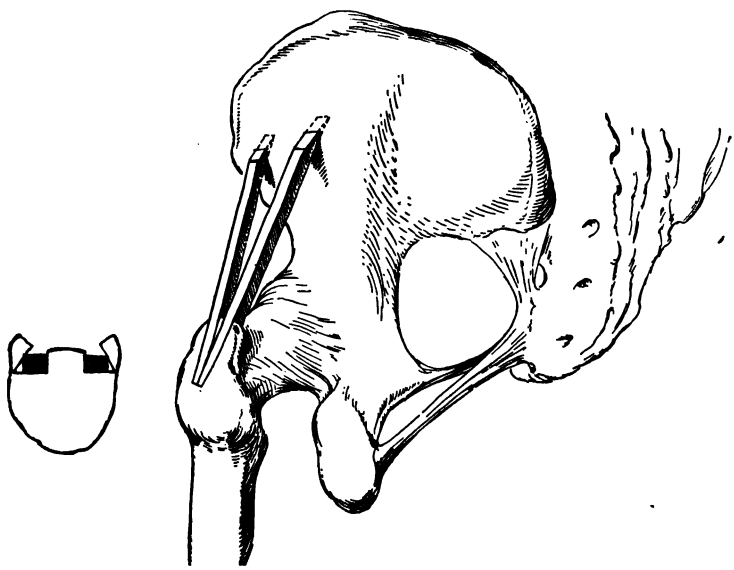

Fig. 166.—Method employed by the writer since 1912 for extra-articular fixation and support of the hip-joint affected by tuberculosis or other destructive lesion. Two tibial bone-grafts are used: one end of each is inlaid in the great trochanter, the other end is made wedge shaped and driven into mortise made in the wing of the ilium. (From Albee, "Orthopedic and Reconstructive Surgery.")

outer surface of the ilium and its outer end in the groove made by turning up the trap-door from the trochanter.

With the aid of the Albee "bone set" placed against the head of the osteotome and blows of a mallet the cutting edge of the osteotome was driven through the outer table of the ilium, producing two mortices in the outer table of the ilium and extending into the cancellous bone beneath; these were situated 3

inches apart and 2 inches above the hip-joint. The length of the desired grafts was then determined by the aid of two flexible probes.

The wound was then packed with a large hot saline compress, and the anterior internal surface of the tibia was exposed by a curved incision over the crest of the tibia extending from just below the tubercle of the tibia to about 3 inches above the ankle-joint. Grafts of the desired length and about ½ inch wide were then mapped out in the central portion of the anterior internal surface of the tibia, one above the other. With the Albee twin saw adjusted at a distance of ½ inch apart parallel cuts were made in the center of the antero-internal surface of the tibia. The upper ends of the graft were then beveled on the periosteal side (Fig. 166) while severing them with the Albee cross-cut motor saw. These grafts were then dislodged by means of the osteotome and mallet, retaining all the marrow substance that clung to them. The grafts were then placed in the beds prepared for them at the hip; the beveled ends of the grafts were placed in the mortises in the sides of the ilium, with the beveled surfaces outward, and other ends being placed in the grooves in the trochanter. By means of the "bone set" placed against their trochanter ends and blows of a mallet the grafts were then driven for a distance of about ½ to ⅔ inch into the mortises already prepared in the side of the ilium. The purpose of beveling the upper ends of the graft on their outer side was to cause the lower end to press firmly into the trochanter gutters when the grafts were driven into place.

The trochanter trap-doors were then pulled over the lower ends of the grafts by means of interrupted sutures of fine kangaroo tendon placed in the peri-osseous soft parts. These were the only fixation ligatures necessary. The muscles were drawn together above the grafts by means of a continuous suture of chromic catgut No. 1, and the skin was closed by means of a continuous suture of No. 1 plain catgut. The tibia skin wound was treated likewise. The suture holes were puddled with 3½ per cent. tincture of iodin, and generous dressings of gauze and sterile absorbent cotton were applied.

The limb was then immobilized with a long well-molded plaster-of-Paris spica extending from just above the costal margin to the base of the toes.

The convalescence of this case was uneventful. The wounds healed by primary union, and the grafts grew in most satisfactorily (Fig. 167). The pain, which had not previously been relieved by the most careful bracing, ceased entirely. This patient was sent to the Burke Foundation at White Plains shortly after the operation in 1912 for proper environment and convalescence. She did remarkably well there, and was transferred from

Fig. 167.—A skiagram taken eight weeks after insertion of grafts.

the patient list to the employees' list, and is still employed there at the present time.

The *x*-ray study of the proliferation of these grafts is most interesting (Fig. 168). The immobilizing effect of the grafts brings the largest amount of stress upon them, at or near the fulcrum point at their lower ends, and this is where the greatest amount of proliferation and increased thickening of the grafts has taken place. Estimating from an *x*-ray study, the grafts have increased their diameters about eight to ten times at their trochanter ends, while they have proliferated only three to four at their cross-section at their iliac or upper ends.

Case V.—Rev. C. C. L., referred by Dr. Howard Kelly, of

Baltimore, was fifty-two years of age. At the age of nine he began to have pain in the right hip when walking. He could walk only about six blocks, after which the pain became so great that he had to stop. He has been handicapped all his life by this painful hip. During the past year the hip became much more painful and stiff, so that he has been able to take very little

Fig. 168.—A skiagram of the same case as Fig. 167 taken eight years after the insertion of the grafts. The remarkable increase in density and diameters of the grafts, especially at their lower ends where leverage stress occurs, is striking.

exercise and has become very heavy. He can scarcely walk two blocks now. In the past few months the pain and stiffness have become excessive. Has had a number of treatments by electricity and radiant light. He has had no sore throats or evidence of tonsillar infection, and the *x*-ray plates of the teeth are negative for focal infection. The Wassermann reaction also is negative.

Excepting for the condition of the hip, his health has always been excellent.

Examination: Abnormally heavy, the patient walks with a marked limp of stiffness, shortness, and pain; and stands with the right extremity rotated outward, flexed, and adducted. With the patient on the examining table in the dorsal position the distance from the right anterior superior spine of the ilium to the internal malleolus was $33\frac{3}{4}$ inches; on the left, the same measurement was 34 inches. From the umbilicus to the right internal malleolus the measurement was 36 inches; the same measurement on the left side was $37\frac{1}{4}$ inches. This disclosed an actual shortening of $\frac{1}{4}$ inch and a practical shortening of 1 inch due to the adduction flexion deformity. There was a marked atrophy of the muscles of the thigh and leg. The right leg was markedly rotated outward, adducted, and flexed to 120 degrees, with about 10 degrees of motion. Rotation, abduction, and adduction were practically nil at the hip. All attempts at passive motion elicited severe pain.

The *x*-ray examination by Dr. B. C. Darling revealed a very advanced osteo-arthritis of the right hip-joint (Fig. 169). In view of the deformity and the severe pain from locomotion and all movements of the hip, it was decided to do an operation to bring about ankylosis of the hip-joint. This treatment of osteo-arthritis of the hip-joint was first reported by the writer at the International Medical Congress at Budapesth, Hungaria, in 1909. Since that time 120 such cases have been operated upon by me with excellent results.

Three years ago, after reading the report by a colleague of favorable results obtained in such cases by arthroplasty, I was stimulated to try to maintain motion and still do away with pain by chiseling off a large portion of the overgrown head and molding it into a spheric shape. The acetabulum was left undisturbed. Four cases were selected for this treatment. They were all operated upon over a year ago, and have all proved unsatisfactory, in that the patients still have pain and discomfort and are not satisfied with the results of the treatment. In view of this experience, I am naturally more than ever convinced that in

this particular monarticular condition fixation should be the aim of the treatment. Bracing or plaster-of-Paris splints are especially unsatisfactory in these cases, in that after the brace or splint is worn for many years the painful condition still remains, undoubtedly largely because it is a degenerative and not a bacterial process. Patients with this condition are apt to be obese because of the absolute interference with all forms of exercise, and this again adds to the difficulties of immobilization

Fig. 169.

by any external means. This was especially the case in this instance.

Attention may here be called to the age of this patient, fifty-two years, and the fact that he has been suffering from this condition practically all his life. Osteo-arthritis of the hip has been called senile coxitis, but it is not essentially a condition of the aged, for it may occur at all periods of life. In this instance it began at nine years of age, and I have seen many others begin at an age not much over this. It has been classified from the clinical *x*-ray standpoint as a hypertrophic type of arthritis deformans; from the pathologic standpoint it has been classified as the degenerative type of arthritis deformans.

Operation.—With the patient in the dorsal position on the Albee fracture-orthopedic table, the feet were covered generously with plaster cotton and bound to the traction foot-pieces with 4-inch muslin bandages. The hip-joint was reached by the Sprengel or Smith-Pedersen approach. The skin incision was made along the crest of the ilium from a distance of 5 inches posterior to the anterior superior spine forward to the anterior superior spine itself, and then straight down for a distance of 4 inches. The fascia lata was cut parallel with the crest of the ilium and about ½ inch below it, thus furnishing a means of suturing the fascia lata to the crest of the ilium later on when closing the wound. The gluteus medius, minimus, and tensor vagina femoris muscles were then separated subperiosteally from the side of the ilium by means of a broad osteotome, and carried downward to the superior surface of the hip-joint. This triangular skin and muscular flap was then completed by blunt dissection down from the anterior superior spine and just outside of the sartorius muscle. This gives the best exposure of the hip-joint.

The joint capsule was then laid open by a T-shaped incision, the top of the T being parallel to and just below the rim of the acetabulum. By attempting to rotate the femur in and out a close inspection of the joint confirmed the *x*-ray findings, namely, that there was an extensive rim of osteophytes extending from the rim of the acetabulum and also from the outher rim of the femoral head. The synovial membrane and hyaline cartilage were largely absent from the top of the femoral head, in fact, this portion of the head had the well-known worm-eaten appearance caused by the bone being actually worn away after the loss of the cartilage. The bone was also polished and glittered like marble.

With a broad chisel and mallet a large portion of the osteophytes on the rim of the acetabulum was removed; and with the same instruments about one-fifth of the top of the head of the femur was removed through a plane sloping inward and upward, and also with the same instruments the top of the acetabulum was transformed into a flat surface. While the femur was being rotated strongly inward and outward, all accessible cartilage

was removed from the remaining portion of the femoral head. This allowed the freshened plane surfaces of the femoral head and the acetabulum to come nearer together, though not in close proximity.

The table was then so adjusted as to bring the foot straight up and the limb was abducted at the hip about 10 degrees and flexed about 10 degrees. The digital fossa on the inside of the trochanter was then deepened by means of a narrow osteotome and mallet, thus making a groove about $\frac{1}{3}$ inch wide and about $\frac{3}{4}$ inch deep in a plane parallel with the outer surface of the ilium just above the acetabulum.

With the point of a scapula a large graft was then outlined on the outer surface of the ilium, $3\frac{1}{2}$ inches long by 2 inches wide, its lower end including the superior rim of the acetabulum. With the Albee motor saw the graft was then cut through the outer cortical table of the ilium according to the pattern outlined. It was then removed from its bed with a broad thin osteotome.

If care is not exercised in this work the inner cortical table of the ilium will be damaged or a portion of it removed.

The large rectangular graft thus obtained was turned end to end, and what was the upper end was thrust firmly into the groove in the upper end of the femur, the other end placed in the lower end of the gutter formed by removing the graft as shown in diagram (Fig. 170). In a way, this is another application of the speaker's inlay graft which he has so frequently used in ununited fracture of the long bones.

The wound was then closed with a continuous suture of chromic catgut in the fascia, and a continuous suture of No. 1 plain catgut in the skin. The approximation of the affected muscles against the side of the ilium thus secured was very gratifying. It may be noted that this approach does very little damage to the muscles and other soft parts of the hip, and it constitutes almost an epoch-making event in the plastic surgery of the hip-joint. The speaker uses this approach for all plastic operations upon the hip-joint, reserving the anterior incision for approaches to the neck of the femur only.

The suture holes in the skin were then puddled with $3\frac{1}{2}$ per

cent. tincture of iodin, extensive dressings of gauze and sterile absorbent cotton were placed over the incision, and a long plaster-of-Paris spica was applied from the base of the toes to 2 inches below the costal margin on the right side and 3 inches above the costal margin on the left. This splint was worn for a period of eight weeks, after which an *x*-ray plate was taken which indicated firm union of hip surfaces and graft (Fig. 171, *a*). The patient was allowed up and about on crutches, bearing some weight on the foot.

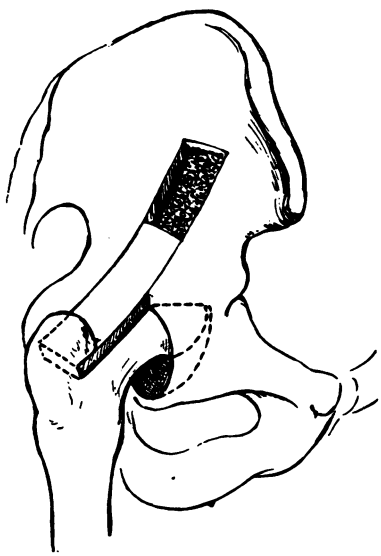

Fig. 170.

Fig. 171.

The subsequent convalescence of this patient has been most satisfactory, in that all pain has ceased, and he takes a rather paradoxic view of the result of the operation, in that he says he has more motion of the hip now than before the operation. This attitude of the patient has been noted in a number of other cases, and is accounted for by the fact that the absence of pain overcomes the muscle spasm at the lumbar spine, knee, etc., to such a degree that compensatory action of the surrounding joints is surprisingly restored. Although the operation destroys the motion of the particular joint, nevertheless, from the point of view of the patient, the results are brilliant.

CLINIC OF DR. LEO BUERGER

NEW YORK POLYCLINIC MEDICAL SCHOOL AND HOSPITAL

CLINICAL LECTURES ON SOME COMPLICATIONS OF URINARY LITHIASIS

BELIEVING that you will obtain a more vivid and concrete conception of the pathology, clinical course, and surgical therapy of certain of the complications of urinary lithiasis through a consideration of clinical material rather than by a didactic scientific exposition, I beg you to be indulgent enough to follow me through the lessons that can be drawn from these interesting and illuminating cases. We shall not attempt a comprehensive exposition of all of the possible complications of urinary stone, for volumes could be written upon this single subject alone. Let us rather confine ourselves to an analysis of a few striking and valuable examples.

And so, for our series of clinics, we shall begin with a discussion of:

First, Calculus in the ureter with symptoms simulating intestinal obstruction.

Second, Anuria and reflex suppression of urine.

Third, A. Perforations of the urinary tract:

(*a*) Perforations of the kidney.

(*b*) Perforations of the pelvis.

(*c*) Perforations of the ureter.

B. Potential perforations:

(*a*) Of the kidney.

(*b*) Of the renal pelvis.

(*c*) Of the ureter.

I. URETERAL CALCULUS WITH SYMPTOMS OF ILEUS

Calculus of the Ureter with Symptoms Simulating Intestinal Obstruction and Even Peritonitis.—We are not infrequently called to see patients at their homes in whom cursory examination might lead us to diagnosticate intestinal obstruction. Where a history of previous lumbar pain has not been obtained, and where the existence of costovertebral tenderness, or pain radiating from the lumbar region into the groin, iliac region or testicle, has not been elicited, particularly when blood in the urine is absent, it has not infrequently occurred that an exploratory laparotomy has been advised.

That such a procedure may be fatal when we are dealing with a case of impacted ureteral calculus producing symptoms of ileus I have had occasion to observe in a patient who was operated upon in one of our large hospitals. In this case the diagnosis of intestinal obstruction was made, and a laparotomy performed. Nothing was found but some doubtful adhesions, and the patient succumbed shortly thereafter with uremic symptoms due to suppression of urine, and the autopsy showed a calculus blocking the lower left ureter.

During the last five years I have been able to diagnosticate 7 such cases, all of which gave the symptoms of intestinal obstruction. Let us comment on the vagaries in the symptomatology of ureter stone in a discussion of the following case, the clinical course of which, briefly summarized, would read:

Case I.—Impacted, Obstructing Ureteral Calculus, Dilated Ureter and Renal Pelvis, with Manifestations Now of Intestinal Obstruction, Now of Peritonitis; with Fever, Abdominal Distention, Rebound Tenderness; Completely Relieved and Cured through Cystoscopic Methods that Caused Expulsion of the Stone.—L. S. B., male, presented the following clinical picture: A distended abdomen, constipation, severe pain in the left iliac fossa, rigidity of the left iliac region, distinct rebound tenderness, and per rectum a small indefinite mass, high up in a culdesac on the left side. Cystoscopy (October 4, 1919) demonstrated that there was urinary retention in the left ureter and kidney, for about 1 ounce of turbid urine, containing some red

blood-cells, without pus, could be collected in a continuous stream when a catheter was inserted some 10 cm. into the ureter. These data suggested a calculus low down in the ureter, with a dilated ureter and acute hydronephrosis.

In spite of the relief that was afforded in this case through emptying the kidney, distinct aggravation of the symptoms occurred the next day, when the temperature rose to 102° F. in the afternoon. It was surmised that by virtue of the swelling of the ureter obstruction had again taken place, so that catheterization of the ureter was again in order. On the following day (October 5th) the tongue was coated, the left side of the abdomen was hard, with board-like rigidity, the temperature was 103° F., and the patient was unable to take food; in short, symptoms suggestive of intestinal obstruction and possibly peritonitis. On October 6th, therefore, catheterization of the left ureter was done again, and the same phenomena of retention of urine could be demonstrated. So great was the accumulation that pressure over the kidney and bladder region as well as over the left iliac fossa increased the flow through the ureteral catheter. Two ureteral catheters were then inserted into the left ureter up to the kidney, and the cystoscope removed, *the catheters being allowed to remain from the time of insertion* (3 P. M. on October 6th) *until the next morning* (9.30 A. M.). On October 7th the abdomen was distinctly less rigid, and the patient's condition considerably improved, the temperature having dropped to 100° F. The catheters were then slowly withdrawn simultaneously, and as they were pulled out it seemed that an obstruction to their exit could be distinctly made out. As their tips emerged this resistance was seen to be due to the extraction of a ureteral calculus that was tightly adherent to the two catheters. It had not been detached throughout its passage from the ureter into the bladder and urethra—a most remarkable and unusual occurrence. From then on the patient made an uneventful recovery.

II. ANURIA AND REFLEX SUPPRESSION OF URINE

Complete anuria over varying periods, days, and even lasting a week, is an alarming but not necessarily irremediable eventu-

ality as a sequence of any of the following lesions of calculous disease:

First, Bilateral renal blockage.

Second, Bilateral ureteral blockage.

Third, Unilateral reno-ureteral blockage, with reflex functional suppression of the other kidney.

Fourth, Unilateral reno-ureteral blockage, with acute infection and urinary suppression of the other kidney.

Fifth, Bilateral renal infection with calculus.

Sixth, Unilateral blockage with anomaly, maldevelopment, aplasia, other pathologic lesion, or postoperative malfunction of the other kidney.

Seventh, Chronic nephritis with unilateral or bilateral blockage.

These are some of the more common conditions that you must have in mind when confronted with the problem of relieving surgical types of urinary suppression. Nor must a purely medical or so-called "nephritic" anuria be the diagnostic label for those patients who are said, by their family physicians, to have Bright's disease. For, even in some of these, complicating, undiscovered lithiasis may be the motivating factor in the sudden arrest of function.

In short, our patient with steadily diminishing urinary output, or with sudden cessation of the same, whether localizing symptoms be present or not, should be approached for diagnostic appraisal in this sense: Is the condition

1. Medical (nephritis) alone?

2. Medical with superinduced mechanical or infectious surgical complication?

3. Reno-ureteral blockage with or *without* localizing symptoms?

For, without careful analysis and urologic investigation, you may lose patients whom either a simple cystoscopic procedure, with or without correct surgical intervention, could possibly save.

Remember that anuria lasting for a number of days can frequently be abolished and the patient cured by decapsulation and nephrotomy. Not infrequently do we encounter examples

of bilateral calculous disease in patients who make unreliable and unintelligent observations; or, we are consulted by physicians whose opportunities for the clinical study of their cases have been inadequate. And so it happens that we are told that the suppression of urine has set in without symptoms, and without suspicion of the existence of urinary lithiasis.

Where a patient has bilateral calculous disease, and the process advances for years without signs, anuria may unexpectedly supervene.

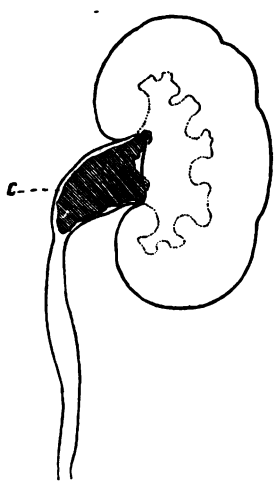

Fig. 172.

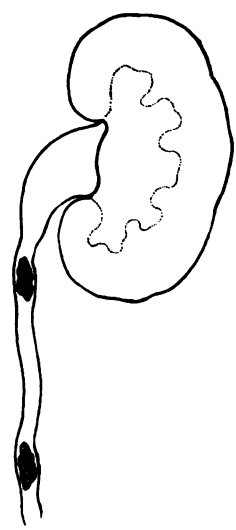

Fig. 173.

Fig. 172.—Diagrammatic representation of a large stone blocking the extrarenal pelvis, with moderate dilatation of the intrarenal pelvis.

Fig. 173.—Fairly marked dilatation of the pelvis with one or more stones in the ureter.

Then you must weigh the possibilities already outlined in a previous clinical talk. Consider whether the patient has been living on one kidney, with the other practically destroyed. Reflect on the assumption that infection or blockage of the remaining functionating organ may be responsible for the total disappearance of secretion. And do not exclude the more grave situation where the patient is in the terminal stages of functional

imbalance with both kidneys markedly involved, the better kidney having become suddenly shut off or infected.

Since the visual memory so frequently is of value in awakening our powers of differential diagnosis, it may be well for you to glance at the pictures I now present to you, for these offer a few of the possibilities in reno-ureteral lithiasis that may be responsible for the sudden advent of anuria.

Thus in Fig. 172 a large stone occupies the greater portion of the extrarenal pelvis. Should infection suddenly occur, or were there an associated ureteral calculus in the other tract,

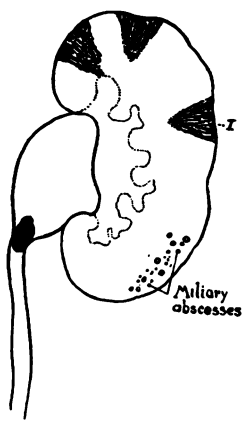

Fig. 174.

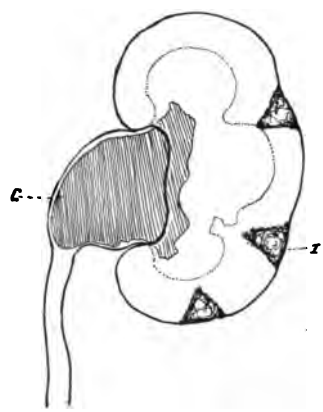

Fig. 175.

Figs. 174, 175.—Diagrammatic representation of suppurative lesions associated with stone.

anuria might ensue. In the same picture, on the right (Fig. 173), the favorite sites for the impaction of ureter stone are shown, namely, near the ureteropelvic junction in the upper lumbar region, and at a point about 4 or 5 cm. above the bladder. With this there is associated a moderate or marked dilatation of the ureter and pelvis of the kidney, and, if sudden incarceration occurs, reflex suppression of the other kidney may occur.

We must remember that with a stone impacted at the ureteropelvic junction (Fig. 174) suppurative invasion of the kidney, as seen in this illustration in the form of pyramidal infarct or

miliary abscesses, may supervene at any time, possibly associated with reflex suppression of the function of the other kidney.

Or, with a large stone or multiple stones in the pelvis causing chronic blockage and hydronephrosis, suppurative and even gangrenous inflammation may occur (Fig. 175).

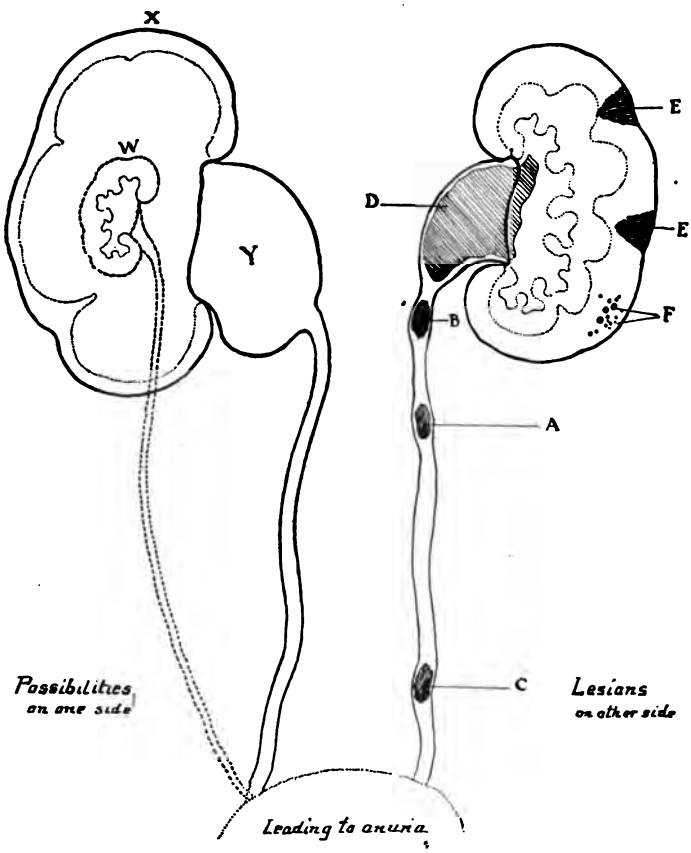

Fig. 176.—Schematic drawing showing some of the possibilities that may lead to anuria when stone complicated with infection is present on one side, with malformation or anomalies on the other side (*W*), or congenital hydronephrosis (*X*, *Y*), or other malformation.

Finally, any one of these or a combination of these lesions as seen in the right half of Fig. 176 may be associated with congenital or mechanical obstruction on the other side. In Fig. 176,

on the left, *W* represents an atrophic hydronephrosis (congenital); *X*, *Y*, large hydronephrosis usually of the congenital intermittent type. On the right, favorite sites of stones in the ureter are shown (*B*, *A*, *C*); *D* indicates the usual type of large stone blocking the pelvis; *E* indicates suppurative infarction in the cortex of a hydronephrotic kidney; *F*, miliary abscesses.

Let us inquire into the diagnosis and surgical indications of a case of this type, the one I am about to offer for your consideration today—a man seventy-eight years of age, who, without prodromal symptoms, noticed complete cessation of the urinary function. The clinical history teaches us how insiduously destructive of the renal organs calculous disease may be; and how devoid of symptoms, how completely unconcerned of the existence of any hazard, a candidate for anuria and uremia may go about his daily pursuits.

III. ANURIA DUE TO BLOCKAGE

Case II.—Anuria of Six Days' Duration, Ureteral Bilateral Urinary Lithiasis, Ureteral Blockage, Without Pain, Nephrotomy and Decapsulation.—A male, seventy-eight years of age, is said to have been in good condition, having been up and about, except for what has been regarded as rare cardiac attacks, who has been living on his left kidney, the sister organ being the site of a calculous pyohydronephrosis. It was not until the other kidney became blocked by the impaction of a ureter calculus that symptoms set in, the only manifestation being *sudden suppression of urine.*

He is said to have had an attack of "retention" about two years previously (history taken November 16, 1920), this having been relieved by a catheter. On November 14, 1920 he merely noticed that he was unable to void any urine, believing his bladder to be empty. Shortly thereafter (a period of fourteen hours having elapsed) vomiting set in, and he began to feel dizzy and restless, and his bowels refused to move. Catheterization of the bladder drew forth merely purulent material, somewhat less than 1 ounce in total quantity. He went along for several days in this fashion, when on November 16th his pulse

became rapid, 120; he vomited several times, his mentality was clear, and still he was able to get about, no urine having been passed for more than forty-eight hours.

On the fourth day after the onset of symptoms, after consultation, at which the possibility of ureteral blockage was suggested, cystoscopy and *x*-ray were carried out. *x*-Ray examination showed a large calculus, 2 inches by $\frac{3}{4}$ inch in diameter, in the pelvis of the right kidney, of the spearhead variety, with its tip abutting against the ureteropelvic junction, doubtless a stone that had caused obturation in that pelvis for some time. No calculus could be detected in the *x*-ray on the left side, but the plate was somewhat obscured by gas.

Cystoscopy demonstrated an obstruction at some 2 cm. above the *left* ureteral orifice, and no urine could be obtained from the left kidney. Catheterization of the *right* kidney evacuated a small quantity (about 15 c.c.) of turbid, watery urine, containing no urea or pus.

From this we could make the following tentative diagnosis: that the right kidney had been shut off for some time, was the seat of calculous disease with almost total inhibition of the function (possibly destruction) of the kidney; and that recently the left ureter had become occluded.

With a non-functionating right kidney, whose function was either inhibited or destroyed, and blockage of the left, and with a history of anuria, operation on the left kidney, the organ on whose secretory potentialities we could best rely, was advised, *but consent was withheld.* In such cases, therefore, there is nothing left for you to do but to make another attempt to overcome the ureteral obstruction with the cystoscope, which was done on November 17th, when it was possible to insert the catheter somewhat higher (about 6 cm.), a fairly large amount of thick purulent material being thereby forced to escape alongside of the catheter through the ureteral orifice.

You will not uncommonly encounter just such a condition of accumulation of *pus in the ureter,* when, by reason of ureteral inflammation and retention of urine in the kidney, pus accumulates in the lower end of the ureter by gravity.

When five days had elapsed without the passage of a drop of urine, acquiescence to operation on the part of the family was finally obtained.

Nephrotomy and Decapsulation for Anuria.—If you will follow me in this operation upon a patient who had run along for more than five days with total abolition of the renal function, two surprising circumstances may appear to you as worthy of note. First, that such a patient could still be in fairly good condition without any of the convulsive symptoms of uremia, an observation strongly insisted upon by Ascoli and other writers on uremia; and second, that immediate relief and immediate resumption of renal function measured by quantities of urine even above the normal should have followed immediately after decapsulation and drainage of the pelvis of the kidney.

We make the oblique Albarran incision of much shorter length than is our custom, since our objective is merely drainage of the kidney. As we expose the perirenal tissues, the inflammatory nature of the envelope and the edema are noteworthy, and, as the envelope is liberated, there is a gush of bloody urine due either to rupture of an attenuated portion of the renal cortex, or the enormously distended renal pelvis. I shall not investigate just where this urine comes from, for I believe it is unimportant. It would appear to be probable that it has its source in the rupture of the pelvis, for you see how tense and board-like and how hard the kidney itself is. We lose no time, but proceed rapidly with decapsulation; we penetrate the cortex behind the midline somewhat below the middle in the "bloodless" area of the kidney with a dressing forceps, explore the kidney pelvis for stone, find none, insert a tube, control some of the oozing by a packing, drain the perirenal space with a tube, and suture the walls in the usual way.

Further Course.—You have asked me what has become of our old patient with a protracted anuria. Within the first three hours after nephrotomy $2\frac{1}{2}$ ounces of urine were passed through the drainage-tube, the first urine evacuated since more than five days. During the first twelve hours the urine was quite bloody, as we expect in nephrotomies on congested kidneys of this type. More than 30 ounces were collected during the

first twenty-four hours after the operation, the patient's mentality being clear, although the pulse remained rather rapid. On the second day 51 ounces were measured through the drainage-tube, and but 4½ ounces were voided, the latter probably representing some of the secretion from the other kidney. The patient went along for six and a half days after the operation, the renal function remaining good, succumbing finally to cardiac failure. While the lethal outcome in this case must be admitted, the recovery of the kidney after operation, the persistently good function, and observation on other cases should convince you of the great value of the procedure of nephrotomy and decapsulation in cases of this type.

Renal Lithiasis and Chronic Nephritis with Anuria.—So also the cases in which Bright's disease has been diagnosticated, whose occasional painless hematuria and ill-defined backache have been interpreted in the light of manifestations of chronic nephritis, may, in truth, be the victims of the deleterious effects of urinary lithiasis, and go to a fatal issue through the exciting influences of the latter affection.

So let me discuss with you today this example of my thesis.

Case III.—Clinically Bright's Disease; Bilateral Ureteral Blockage Due to Stone.—This man's case is of great interest because it teaches how we may underestimate the gravity of the situation in a man who is sent to us for hematuria and "kidney disease" if the coexistence of calculi be unsuspected, and what errors we may make if we do not insist that such patients be cystoscoped when a diagnosis is doubtful.

He (fifty-five years of age) was referred to me with a history of occasional vomiting, sometimes vertigo and headaches lasting from two to four hours, these symptoms coming on at intervals of about two months, and persisting up to the present time. At times he would have burning on urination with some nocturnal frequency. He had had many *x*-rays taken, none of these revealing anything suggestive. During the past three years he has had *edema* of the legs with dyspnea. On occasions there were periods during which he urinated very small quantities. Six months ago he is said to have passed sand, with symptoms of

burning on urination. He had two attacks during the last four months, and directly thereafter noticed that the urine was bloody. He consults me because of an attack of hematuria three days ago, and because of the chronic backache.

Urine examination (May 12th) showed a large quantity of albumin; sugar negative, many hyaline and granular casts and some blood. Blood-pressure 230, diastolic 190. The patient refused cystoscopy.

In view of the backache followed by hematuria, and since the existence of calculi could not be ruled out (although the *x*-ray examinations made were negative), you should report to the doctor (as I did) that you would prefer not to take care of the patient unless he submit to cystoscopic examination.

Since the symptoms did not disappear and the hematuria persisted, he finally consented to cystoscopy five days later. There were definite evidences of *retention of urine* in the renal pelvis. The specimens contained many clumps of pus-cells. *Diagnosis:* Infected hydronephrosis (with calculus in the right ureter); on the left, infection, possibly also with calculi.

Because of a very severe attack of renal colic on the *left side* on May 22d (six days later) cystoscopy was done on the 23d, marked retention of urine being found in the left kidney (opposed to the other side at the last examination) and about 45 c.c. of dark drownish retained urine were collected. This contained microscopically many white blood-cells and some red blood-cells. Therefore a stone had passed into the left ureter, causing damming back of urine.

No specimen was obtained from the right.

Diagnosis: Stone also in the right ureter with no flow from that side; obstruction at about 18 cm.; blockage also of the left ureter.

He had evidently passed calculi in the interval between the 16th and 23d of May into both ureters, establishing a proved infected hydronephrosis on the left side and *complete blockage* of the right.

Now, uremic symptoms began to make their appearance, and his mentality was not clear. On May 24th, the day after

cystoscopy, in spite of the fact that the left kidney was drained of its retained fluid, there was evidence of *anuria*, since practically no urine was drained for a period of twenty-four hours, symptoms of uremia becoming more and more pronounced.

So another cystoscopy was done yesterday. An obstruction was again encountered at about 17 cm. in the right ureter; *no urine was obtained.* The obstacle in the left ureter was overcome, and about 45 c.c. of dark brown fluid were evacuated from the left ureter. The catheter on this side was then allowed to remain in the left kidney.

Are the conditions in this case clear to you? Both ureters have become blocked by stone. I was able to drain the left with the ureter catheter which was left *in situ*, and *on two occasions I was unable to get a drop of urine from the right kidney;* for a stone was evidently lodged 18 cm. above the bladder. The house physician tells us that the drainage through the ureter catheter from the left kidney has been inadequate, that his general condition is not improving, and that there was *no urine in the bladder.* This means that the right kidney has still been unable to expel any of its contents downward into the bladder. What shall we do? Shall we operate on the left kidney or on the right? It is evident that in the left kidney, at least, we have been able to enter with our catheter, while the right is completely shut off, *so I shall decide to explore the right side.*

Operation—Nephrotomy, Ureterotomy, Decapsulation.—Now I am exposing an extremely hard, tense, and enlarged kidney. See how enormously distended the ureter is in its upper portion; and as I palpate I feel the stone exactly corresponding in situation to the point where the ureter catheter met the obstacle, well incarcerated in a narrow portion of the ureter. Do you see how this small incision permits the catheter to be easily extracted, and that one suture closes the ureter? I am now making a small opening into the kidney, inserting a drainage-tube, and decapsulating. There is quite a gush of urine from the kidney as I enter the cortex of the kidney with a dressing forceps, since this organ has been acutely distended.

Subsequent Course.—Drainage from the right kidney was

immediate, copious, and in forty-eight hours the patient voided a fairly good quantity.

In spite of the restoration of the renal activity, however, the patient became uremic again six days after the operation, exitus occurring on the seventh day.

Ureteral Calculus with Reflex Anuria.—Although it is well recognized by the urologist that unilateral ureteral obstruction by a stone, particularly by a descending ureteral calculus, may be followed by reflex suppression of urine, the urgency of instituting immediately very simple methods of relief is not universally recognized nor accepted by the internist. Therefore, not only for diagnostic purposes but for rapid amelioration or even complete abatement of symtpoms, should you have recourse to cystoscopy and ureteral catheterization, for this you will find is a most reliable means for renewing the activity of the kidneys.

In your practice you may meet with two distinct types of suppression of urine due to impaction of a calculus in the ureter, and these, for the sake of the discussion of therapeutic measures, may be grouped as follows:

First: Single or repeated attacks of suppression of urine, due to a calculus usually in the lower end of the ureter, permanently relieved by the passage of the ureteral catheter, with or without the early expulsion of the stone.

Second: Single or repeated attacks of reflex anuria or suppression of urine from the same cause, relieved by the same method, until the impaction becomes such that ureteral catheterization becomes impossible, ureterotomy being indicated.

With the acquisition of sufficient skill in the manipulation of the ureter catheter you will find that most cases of suppression of urine can be relieved by cystoscopy alone. It is a peculiar circumstance, and one worthy of note, that most symptoms of intestinal obstruction, and those of reflex anuria, are more apt to occur when the ureter calculus is impacted in the pelvic portion of the ureteral tract. It is in this situation that my two-catheter method of manipulation will rarely fail to mount the obstacle and to drain off the retained urine from both ureter and the pelvis.

One or both catherers must then be allowed to remain *in situ* for a sufficiently long period of time to awaken the inhibited function of the other kidney, as well as to thoroughly drain the affected side.

What should this period be? This will depend upon the duration of the suppression of urine, the difficulty we have experienced in overcoming the obstruction, the amount of edema of the ureteral orifice, and our appraisal of our subsequent chances of being able to pass the catheter again, if occasion should require. Where the suppression of urine has lasted for a considerable period of time it will be wise for you to allow the catheter to remain for several hours, possibly overnight, or even longer. So also, when the edema of the orifice is marked, and the difficulty attending the surmounting of the obstacle was great. When, however, the ureteral blockage does not seem to be so marked, and where previous attacks of ureteral colic and the passage of stone has dilated the ureter considerably, and our estimate suggests an easy repetition of these cystoscopic manipulations, it may be permissible to be satisfied with a ureteral drainage over a period of half an hour or an hour.

Reflex Anuria that Responds to Ureteral Catheterization.—Let me bring to your notice a concrete example of such a case, so that you may not be in doubt as to the preferability of non-operative procedure when you are confronted with a similar clinical picture.

Descending Ureteral Calculus, Intense Renal Colic, Suppression of Urine, Complete Relief by Drainage with the Ureter Catheter.—J. B., fifty-six years of age, male, had had a similar attack of renal colic fourteen years previously, and then another attack three years ago, both of which subsided spontaneously.

x-Ray examination on December 29, 1920 showed an elliptic shadow $\frac{5}{16}$ x $\frac{3}{16}$ inch in the path of the right ureter, about 3 cm. from the site of the bladder orifice of the ureter.

Because of suppression of urine lasting some eighteen hours the patient was brought to the office on December 30, 1920, and cystoscopy demonstrated an obstruction in the right ureter just above the orifice. By manipulation with two catheters it

was possible to insert a catheter beyond the obstruction and drain a considerable amount of bloody retained urine, and because of the suppression it was decided to leave the catheter *in situ*. For this purpose the patient was transported to the hospital, where the catheter drained copiously from the kidney. At 10 P. M. on December 30th (the same day) blockage of the ureter catheter had evidently taken place, and it was manifest that this was evidenced by an attack of intense colic, which was immediately relieved by overcoming the obstruction in the ureter through the injection of some boric acid. On the following day the patient voided normal quantities of urine alongside of the catheter, and on January 1st the catheter was removed, the patient having completely recovered.

Reflex Suppression of Urine Due to Impacted Ureteral Calculus Requiring Ureterotomy.—It is in the cases in which your efforts to pass the obstacle with the ureteral catheter are unavailing that you may have to resort to ureterotomy. Were it not for the fact that with our modern methods of cystoscopic manipulations so large a percentage of the ureteral stones can be made to pass without operative intervention, this expression of therapeutic indications would be quite beside the point.

Now and then you will encounter cases in which hopes of conservative treatment will be shattered by the sudden lodgment of the stone at a point where the ureteral catheter will no longer be able to pass, and by the synchronous onset of suppression of urine. I have elsewhere brought to your notice in demonstration of other cases how such suppression of urine can be relieved. Now permit me to confer with you regarding another example, in which two attacks of suppression of urine occurred, one of which could be relieved, and the other not, merely because the ureter catheter could no longer be depended upon.

Descending Ureteral Calculus Lodged in the Lower Pelvic Ureter, Continuous Renal Ureteral Pain; Relieved by Ureteral Catheterization; Subsequent Attack with Suppression of Urine; Relieved by Ureteral Catheterization; Second Attack of Suppression of Urine, Necessitating Ureterotomy.—R. M., thirty-eight, female, whom I present to you today, is a woman whom I

found in bed, with a history of having been bedridden for two weeks, with almost continuous pain in the left lumbar region. At times she says that she had intervals of relief, particularly when morphin was administered. Some of the paroxysms of pain were severe and attended with vomiting. About seven months previously she had had a similar attack, and these had been repeated about once a month, and since she had to remain in her bed, two weeks ago.

When you find cases that have undergone a protracted period of pain, evidently due to renal or ureteral stone, it is best to *counsel the application of the cystoscope immediately* rather than to temporize with *x*-ray alone. The passage of the ureteral catheter beyond the obstructing ureteral calculus may give relief at once, besides expediting the passage of the calculus; while morphin is but an exceedingly evanescent, therapeutic measure. A vaginal examination in females will often clear up the diagnosis at once, since incarceration of the stone in the pelvic course of the ureter not far from the bladder is a most common occurrence. It is in this situation that the most marked symptoms are produced, reflex ileus most likely, and even suppression of urine. Through the anterior vaginal wall such calculus can be easily detected, and so it was here at the very first examination.

If you look at the *x*-ray plates of this case you will see an ovoid shadow $\frac{7}{16}$ inch by a little more than $\frac{5}{16}$ inch in the course of the left ureter just above the ischial spine. Both kidneys are normal in size and position. The cystoscope passed (February 28, 1921) permits the left ureteral catheter to demonstrate an obstruction in the left ureter 4 cm. from the orifice in the bladder. But by manipulations the catheter slipped by the retention of urine above the obstruction demonstrated, the urine containing numerous red blood-cells. You will not be surprised when I tell you that relief from pain was obtained.

After you have emptied such a dilated ureter and kidney in a case of ureteral impaction, and given the long-sought-for amelioration, it will be wise for you to call the patient's attention to the fact that his or her suffering may not be altogether at an end,

but that a repetition of the attack is frequently to be expected. Although many of the cases—when the stone is small—will be gratified by an early expulsion of the calculus after one cystoscopic treatment, others will have to undergo a repetition of the ureteral colic, and I therefore advise strongly that after such instrumentation your patient be instructed that another paroxysm may not only occur, but is a *desideratum, in that it may signalize the further descent* of the stone.

So here, although relief was obtained for twenty-four hours, another attack then occurred with suppression of urine.

You will then pass the catheter once more, as was done here. You will find that the urine will pour out in a steady stream with considerable rapidity through the ureteral catheter as you pass the obstruction, and will do well to leave one or two catheters *in situ* for half an hour or more. Now our patient has had relief for three days, had almost refused further manipulations, when a period of twenty-four hours elapsed *with the passage of but 3 ounces of urine.* With this there was considerable pain and discomfort in the iliac and lumbar region, so that the indications were cystoscopy alone, or cystoscopy and ureterotomy.

On March 5th I find that I am unable to pass the ureteral obstruction, and, in view of the suppression of urine, there is naught else for me to do but proceed with ureterotomy.

So on March 5, 1921 the ureter is exposed, and found dilated, inflamed, cyanotic, distended with urine, and the ureter stone about $\frac{1}{2}$ inch in diameter, tightly impacted about $1\frac{1}{4}$ inches above the bladder, from which it could not be dislodged, so that incision had to be made *in situ.* From then on uninterrupted recovery.

IV. PERFORATIONS OF THE URINARY TRACT

The dangers of too much procrastination in the treatment of ureteral calculi, and the error of judgment that will permit the physician to allow a patient to disregard an obstructing stone because symptoms are absent, are practically confirmed by the perforations of the urinary tract due to the pent-up urinary secretions. No definite prognostication can be made as to just what

form of lesion will characterize the alterations in the pelvis of the kidney, the kidney itself, and the ureter by reason of ureteral obstruction. In fact, a multitude of changes may be produced under varied conditions, since a number of different factors play an important rôle in their elaboration. First, you must remember that the lodgment of a calculus in the ureter may at one time produce dilatation of the ureter and kidney by virtue of continued excretion from the kidney, and impaired outflow, and, on the other hand, may be signalized by a total arrest of the excretory function. A careful study of the character of the ureter in the cases in which ureterotomy is performed will attest to the fact that an empty ureter is not an uncommon finding. Although the absence of urinary flow through the ureter catheter when it cannot pass the ureteral obstruction is no indication of the non-existence of the retention of urine above the obstacle, *x*-ray examination in a large number of my own cases has confirmed the operative findings in the presence of a small kidney on the side of the obstruction.

Conversely, more or less acute obstructions are apt, when suppression of urine does not take place, to be attended with considerable dilatation of the ureter, particularly when by reason of former attacks some uronephrosis or hydronephrosis of the kidney has already taken place.

The rôle played by infection, too, is an exceedingly important one, in that it is responsible for alterations not only in the kidney cortex inself but also in the pelvis of the kidney, and in the ureter. Thus, dilatation of the ureter and extrarenal pelvis are not uncommon sequences of inflammatory processes alone.

Furthermore, the conformation of the urinary tract, which, as you know, is prone to anomalies, is another important factor in determining the ultimate lesion.

The resistance of the body, too, and the type of bacteria seems to be influential in shaping the pathologic anatomy. For how else could we explain those slow perforations of the pelvis or ureter due to calculus, that must needs have taken months to occur, with peripelvic or periureteral protective adhesions of inflammatory fat—characteristic of certain cases—and perfora-

tions of the extrarenal pelvis and cortex of the kidney in others, where no adhesive processes or supporting changes can be found.

Perforations of the Urinary Tract.—Let me pass in review just a few examples of such cases, and discuss how the surgical indications will have to be met.

When a perforation occurs it may involve the ureter in any portion, the extrarenal pelvis, and the cortex of the kidney.

Perforations of the ureter are most apt to be situated in the lower pelvic course of the ureter, and in the upper lumbar.

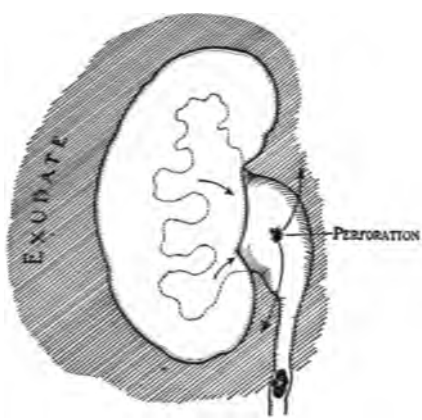

Fig. 177.—Pararenal and parapelvic urinary exudate following perforation of the pelvis, with calculus blocking the ureter.

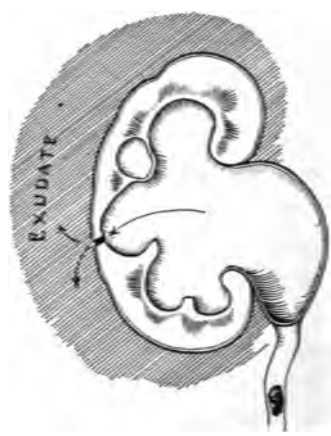

Fig. 178.—Perforation of attenuated hydronephrotic kidney consequent upon ureteral blockage with perirenal urinary extravasation.

Perforations of the pelvis may occur in any portion of the extrarenal pelvis, and those involved in the cortex may or may not be accompanied by rupture of the capsule of the kidney.

Thus, we may divide the urinary extravasations that occur after a perforation as follows:

1. Parapelvic and pararenal (Fig. 177).
2. Perirenal extravasation (Fig. 178).
3. Periureteral extravasation (Fig. 185).
4. Subcapsular extravasation (Figs. 181, 182).

A glance at this chart that I will show you will help explain the

situation of the exudate when the urinary fluid has made its escape from the reno-ureteral system.

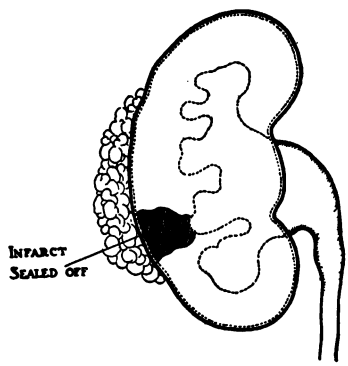

Fig. 179.—Cortical infarction leading to a calyx with protective inflamed fat sealing it off.

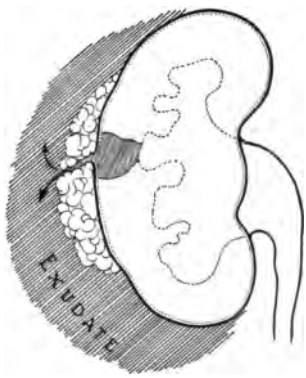

Fig. 180.—Perforation of the protecting fat causing communication between calculus and perirenal tissues.

In Fig. 177 there is a diagrammatic representation of a perforation of the pelvis of the kidney due to distention and

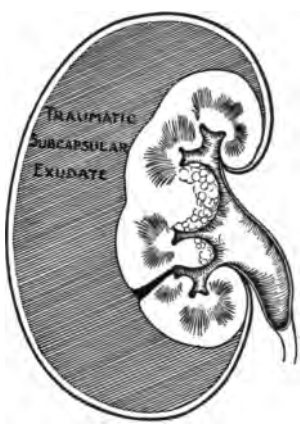

Fig. 181.—Traumatic subcapsular exudate with laceration of kidney establishing communication with calyx.

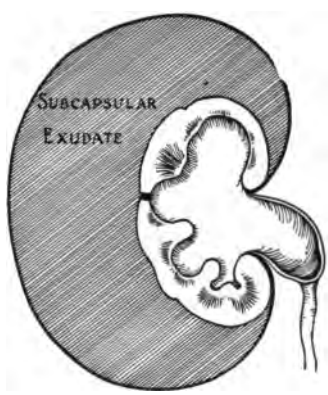

Fig. 182.—Subcapsular exudate accompanying ruptured hydronephrosis, usually of congenital atrophic type.

blockage by a calculus in the upper ureter, with a pararenal exudate of urine, the latter infiltrating the fatty tissues about the kidney, the pelvis, and the upper ureter.

Where there is a perforation of an attenuated cortex in a hydronephrotic kidney, and the capsule is perforated simultaneously, a perirenal exudate as seen in Fig. 178 is the result.

Anemic infarction combined with suppurative infarctions have, in my experience, been seen to be sealed off by inflammatory fatty tissue, so that any communication with the pelvis outward is kept closed (Fig. 179).

But, when by reason of suppuration of the fatty protective envelope, or by blockage of the ureter, a communication is established, the urine finds its way outward as depicted in Fig. 180.

Subcapsular exudates may accompany traumatic rupture of a fairly normal kidney with collection of urine under the capsule, the latter being intact (Fig. 181).

It is not uncommon, however, to find a congenital hydronephrotic kidney, usually of small size, giving rise, by virtue of perforation, to a subcapsular exudate of urine (Fig. 182).

(*a*) **Perirenal Urinary Extravasation.**—Permit me to bring to your notice one of the worst of the forms of urinary extravasation around a kidney, where the proper method of liberating the urinary tract was not applied in good season; a case in which the patient's life was placed in jeopardy, the kidney compromised, a long period of hospital care required, with nephrectomy as the final outcome.

Perirenal Extravasation of Purulent Urinary Exudate Due to Blockage by Ureteral Calculus; Drainage of Perirenal Abscess; Secondary Nephrectomy.—A very sick man, forty-five years of age, with a temperature of 103° F., pale, presents himself for examination on September 18, 1920 (referred by Dr. A Granet) because of intense pain in the left lumbar region, fever, and with a history of having been as sick as this for almost two weeks. A glance at the lumbar region with the patient stripped demonstrated a large swelling with bulging in the costovertebral area and flank extending diffusely as far as the anterior axillary line. This mass gives a sense of deep fluctuation.

The urine is cloudy and contains considerable pus.

One would suspect perforation of the kidney with extravasation of urine and pus, possibly associated with a hydronephrosis.

Cystoscopy demonstrated an insurmountable obstruction about 10 cm. removed from the left ureteral orifice, with a total absence of flow from the left kidney. The right kidney functionated fairly well, although the output of phenolsulphonephthalein was only about 16 per cent, as judged by the total bladder urine over a period of two hours.

x-Ray examinations show a shadow over the middle of the left iliac synchondrosis, suggesting a calculus about ½ inch in diameter.

Diagnosis.—With the evidences of total obstruction of the ureter at hand, the bulging mass in the left flank, the diagnosis of infection of the left urinary tract with possibly ruptured hydronephrosis seemed the most likely expression of the anatomic condition. That such interpretation was the correct one was demonstrated by operation done in the evening of the same day.

Operation.—If you will follow me carefully through the description of an operation for a suppurative process in and around the kidney, a number of valuable points obtained from experience may be worthy of your attention. With careful technic, on the one hand, and with the utilization of correctly applied Carrel-Dakin treatment, suppuration of the rather large incision that kidney frequently requires, need no longer be feared.

In the technic, three points may deserve emphasis: First, the restriction of the size of the incision, where exploration will not be necessary and where we expect to find pus just under the lumbar fascia (as in perinephritic processes and extravasation of urine).

Second, the evacuation of the exudate or pus in the kidney with as little soiling of the wound as possible.

Third, correct methods of suture with the proper placement of wound drains.

The Surgical Technic in Infected Kidney Cases.—Let me, therefore, digress for a moment before continuing with the case I am presenting to you, with a consideration in somewhat greater detail of the recommendation above alluded to.

1. *The Incision.*—For more than 90 per cent. of the ex-

posures of the kidney (for whatever lesion may be present) we advise a modified Albarran incision (Fig. 183) that crosses obliquely from a point somewhat above the anterior superior spine upward and backward to the costoveretebral angle just under the twelfth rib. It is but the posterior portion of this incision that is necessary in the cases when we expect to find pus under the parietes. Where further exploration is necessary for the finding of pus, or where the kidney may have to be exposed

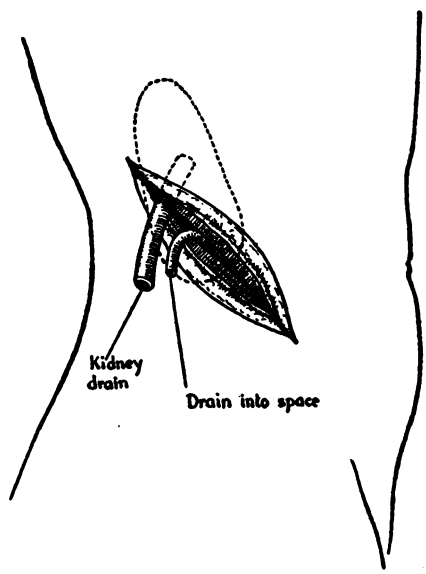

Fig. 183.—Albarran incision with relative situations of kidney and drains indicated; the kidney drain enters the kidney postero-inferiorly, and the depth drain emerges next to the latter, draining the perirenal space.

so as to be properly drained, or a calculus removed through the cortex, a larger incision is necessary.

2. *Technic for Evacuating the Pus.*—If we wish to obtain primary union throughout most of the wound in cases of infection of the kidney or perirenal tissues, it will be well to cover thoroughly the cutaneous, subcutaneous, and muscular tissues with towel and gauze pads, also packing off thoroughly the fatty perirenal tissue. This, however, is not sufficient, and you may

find the following expedient to be of some technical value. Should you expect to find pus immediately under the lumbar fascia, a prognostication that is not difficult, the alterations in the partial plane, such as bluish-pink discoloration, congestion, edema, and thickening are carefully noted—you may perforate this region with a trocar, evacuating most of the pus in this way. Or you may insert a dressing forceps, followed rapidly by the insertion of a tube of adequate dimension, and so also empty the pus without any or very much spilling. So also when you determine upon evacuating the contents of a dilated pelvis of the kidney, you may either use the trocar followed by the insertion of a tube carried in with a curved artery forceps, or a catheter may be directly led into the renal pelvis through a minute opening in the cortex, preliminary escape of fluid being controlled by the left hand. It is not a little gratifying to see how beautifully the wounds even in such infected cases will heal if these measures be carefully followed.

3. *Closure of the Wound Itself.*—Since the adoption of these details in operative technic we have not had the occasion to open widely a single infected nephrotomy or nephrectomy wound. In closing, use catgut only and interrupted sutures in about two layers, avoiding excessive use of suture material. If the posterior angle of the wound gives exit to the tube draining the kidney or perirenal exudate, it is well to insert an additional tube into the perirenal space beside those that will superficially drain the parietes (Fig. 183). A tube of small caliber is led under the skin downward and forward, so as to drain the posterior portions of the musculature, and may emerge together with the other drain. If the incision is large, an additional small tube of Carrel-Dakin caliber may be inserted into the skin, through the skin at the antero-inferior angle of the wound, and, in the worst cases, another is placed between the sutures at about the middle of the incision. These small tubes are employed not only for the purpose of drainage, but for the early injection of the Dakin solution, should this become necessary (Figs. 183, 184).

Further Clinical History of Our Case.—The usual but shorter oblique incision discloses inflammatory signs, adhesions between

the deeper structures of the muscle fascia, and some edema. A dressing forceps is now thrust through the fascia and the opening at once closed with the finger, so that the pus cannot soil the rest of the wound. A large tube now rapidly replaces the finger and evacuates two large pus basinsful of foul, purulent urine.

What shall be the further steps in a case of this sort? With a patient in poor condition, a large perirenal exudate, with the

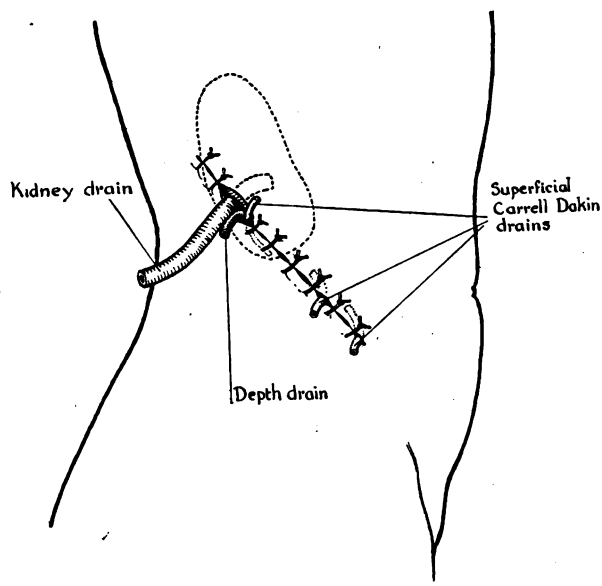

Fig. 184.—Method of closing the wound in infected kidney cases where the kidney is drained (by kidney drain); the latter emerges at a point nearer the postero-inferior end of the incision; the depth drain is adjacent to it, and the small Carrel-Dakin tubes are inserted at two or three places under the skin.

other kidney functionating badly (about 16 per cent. phenol-sulphonephthalein), the immediate indications will have been met when the pus and urine will have been given a free outflow. Nor will exploration of the large cavity with the finger reveal very much as to the exact anatomic condition, nor will it help us to diagnosticate between a perforation of the extrarenal pelvis or the cortex of the kidney itself. We shall content our-

selves, therefore, with the correct treatment of the wound; which is to be carried out in the manner previously suggested. In truth, it was not until at a later date when the kidney was removed that the pathologic anatomy was fully cleared up.

Future Clinical Course.—In such a case we would recommend the early use of Carrel-Dakin solution, with which excellent results are obtained. Indeed, except at the point of drainage, the wound here healed up by primary intention. Thus, the general condition of the patient did not permit further intervention until January of the following year, about three months later. Although such a patient may be up and about, as was this one, you must hesitate in suggesting further operative measures until you feel confident that he or she may be in a condition to weather further surgical procedures.

Indications for Nephrectomy.—What shall the conduct be in a case of this sort, with an insurmountable ureteral obstruction 10 cm. from the bladder? Shall we remove the perirenal drain? Shall we take out the kidney? Shall we operate on the ureter? These are the questions that you must be prepared to answer.

Obviously, nephrectomy will be indicated when the kidney has already been destroyed if the patient's general condition will permit. The function of the affected kidney can be approximately appraised by the phenolsulphonephthalein output through the drainage-tube, which in this case was almost zero after the operation. But you must also resort to a further procedure to get a more accurate estimate, namely, to ureteral catheterization for subsequent information; for in the interim the ureteral obstruction might spontaneously be relieved through migration of the stone, allowing urine to seek its normal path.

Cystoscopy, therefore, was done on several occasions, and the obstruction found to be repeatedly insurmountable.

The general condition of the patient and the function of the other kidney now are to be considered as the guiding factors in our decision as to the advisability of nephrectomy. Can we rely in such a case on the phenolsulphonephthalein output and the retention of nitrogenous products in the blood alone?

As far as the phenolsulphonephthalein output is concerned,

do not rely too much upon it as affording testimony of impaired renal function, for here I am presenting to you a man whose left kidney function was less than 25 per cent. even after drainage of the left perirenal exudate, in whom nephrectomy was carried out without any complications. Remember that continued toxemia due to absorption from a purulent focus may inhibit and impair the integrity of the other kidney to a considerable extent. So be guided rather by the general condition of the patient, and if there are no marked signs of retained nitrogenous products, you will find that nephrectomy will be well borne.

Let your patient, therefore, get about with the drainage-tube in place, keep the latter clean, build up his general condition, and if you feel confident that the ureteral obstruction cannot be overcome, and the kidney function on the corresponding side is so poor that its retention is of no value to the patient, then approach the consideration of doing what was done here—a *subcapsular* nephrectomy.

Subcapsular nephrectomy was carried out on January 10, 1921. The kidney specimen, when examined, demonstrated the fact that a perforation of the extrarenal pelvis must have taken place, the cortex of the kidney itself being intact throughout. The usual lesions of hydronephrosis, marked dilatation of the pelvis, chronic pyelonephritis, and ulcerations of the papillæ were present.

The patient made an uneventful recovery after nephrectomy.

(*b*) **Retroperitoneal Periureteral Extravasation of Urine. Spontaneous Rupture of Renal Pelvis of Hydronephrotic Kidney Complicating Ureteral Blockage by Stone.**—Perhaps no more unexpected and unusual an instance of *recovery* after an operation on the urinary tract has come to my notice of recent years than the following case of bilateral urinary lithiasis that I wish to offer for your consideration today. Not only was the spontaneous closure of a urinary fistula striking in this case, but the whole clinical course and data obtained from cystoscopic examinations offer an unusual amount of food for thought and clinical deduction.

In a man with bilateral urinary lithiasis, with one infected kidney and with an obstructing calculus in the ureter of the other

side, the complications and jeopardy to life that a timely removal of the ureteral calculus in the healthy tract could have obviated are beautifully illustrated. It is examples such as these that are the best clinical lessons in surgical indications.

With the right kidney previously removed for infection, and with the synchronous lodgment of an obstructing calculus in the ureter of the remaining urinary tract, the problem of treatment would seem clear, namely, the early liberation of the affected ureter. The ureteral stone having been allowed to remain, however, our patient comes to us in *critical condition*, with the left kidney function almost completely in abeyance, with his solitary ureter obstructed, and with an infection of the whole supravesical urinary tract; and thus has to run the gamut of complications that all but cost him his life.

An analysis of such cases speaks volumes in favor of the supreme *importance of liberating the healthy* urinary tract, when the other side has been compromised beyond repair. So let us consider the following:

Acute Infection of Solitary (Left) Urinary Tract, Impacted Ureteral Calculus, Ureterotomy, Persistent Urinary Fistula Closed by Drainage of Perirenal and Periureteral Urinary Exudate Due to Spontaneous Perforation of Infected Hydronephrosis.—No more unexpected result has come to my notice of late years than this instance of restitution of a solitary ureteral tract, whose *apparent* impairment of continuity bid fair to require permanent nephrostomy or nephrotomy.

L. L., age thirty-one, male, was first seen on December 3, 1918, the story being that he had had pain in the *left lumbar* region ever since being discharged from a hospital in the spring of 1918, the right kidney having been removed for calculus and infection. Already at that time he is said to have had a stone in the left ureter.

For two days he had had chills and high fever (103° to 104° F.), had been irrational at times, had passed some turbid urine in exceedingly small quantities, the pain in the left lumbar region being very severe.

In short, symptoms of blockage of the left ureter by a ureteral stone complicated with infected hydronephrosis.

Cystoscopy (December 4th) showed an intensely inflamed bladder, a very much swollen left ureteral orifice, and an obstruction *at the orifice*, probably due to edema. This was overcome with the catheter, when suddenly a gush of practically pure pus followed. The catheter could then be passed upward without detecting the obstacle, and about 30 c.c. of purulent urine were collected within an exceedingly short time, the continuation of the flow and its character indicating that there was probably much more in the kidney and ureter.

The *x*-ray examination revealed a triangular calculus in the course of the left ureter on a level with the ischial spine, a point above the edematous obstructed orifice.

It seemed correct to assume, therefore, that we were dealing, anatomically speaking, with an inflammatory narrowing of the ureter at the vesical outlet, above which almost pure pus had collected (ureteritis or gravitation of pus), with a second veritable obstruction about 3 or 4 cm. above this, due to a stone that hypothetically was not a true obstruction in the centripetal sense, but was an effectual barrier to the outflow of urine in the descending or centrifugal sense.

Early intervention seemed indicated. The question then had to be answered, "Should we operate on the ureteral calculus, which was below the pelvic brim, and remove it; should we do a nephrotomy first, or both at the same time, in view of the high temperatures and apparent severity of the renal infection?"

On December 5th it was decided to go in on the left ureter in the usual fashion through a pararectal incision rather than to expose the kidney.

On making the usual incision an interesting finding was encountered, namely, intense edema in the neighborhood of the ureter and in the whole left *iliac fossa* and retroperitonal region. No definite urinary odor was detected, although not sensed for or suspected as possible at the time. The quantity of fluid was noteworthy, however. The ureter was found considerably dilated up to about the pelvic brim, where there was only slight dilata-

tion. The calculus was found about 3½ cm. from the bladder. It could be milked up with some difficulty and removed at a point in almost normal ureter, a sort of pyramidal shaped or conically shaped stone, somewhat smaller than in the picture, being delivered. The usual closure in layers with drainage at the lower angle was carried out. The ureter itself was markedly inflamed, the lower part markedly edematous and thickened.

Although the patient made an excellent postoperative recovery, we were not a little concerned by the *persistent urinary leakage* that took place through the lower angle of the wound. Immediately after the operation and for several days thereafter he complained of exquisite pain in the left lumbar region, and his temperature rose to 103° F. Because of the patient's unbalanced state, his irrational conduct, and almost maniacal tendencies during the first week after operation the importance of the local signs referable to the left loin was underestimated.

As soon as the temperature began to drop and a more calm mental attitude was established, we felt that the suburemic stage had been passed and the outlook appeared more promising. After the second week it seemed that all would be well except for the fact that slight recrudescences of fever occurred from time to time, and the urinary leakage continued.

Cystoscopy on two occasions late in December and early in January demonstrated an obstruction in the lower ureter, so that it could be assumed that the urinary leakage was due to an inflammatory stenosis of the ureter below the point at which ureterotomy had been performed. A circumstance whose significance was not clear at this time, but which seemed explicable in the light of future events, was the fact that although urinary leakage in some quantity or other was present daily, the drainage of urine down into the bladder was large in amount, from 40 to 70 ounces daily. The obstacle encountered in the ureter at cystoscopy, therefore, seemed of relatively little import, since urine in such amounts could traverse the lower ureter.

Finally, in view of the frequently recurring temperatures, and because of a distinct enlargement of the renal mass, it was decided to operate on the left kidney and perform a nephrotomy

with either a temporary or permanent drainage, depending on whether a re-establishment of the patency of the ureteral lumen would occur.

On January 30, 1919 a small lumbar incision was made. It was immediately evident that the tissues were chronically inflamed. On cutting through the fascia, a large amount of purulent urine from about the kidney was evacuated. On exploration with the examining hand it was found that the urine occupied quite a large cavity between the kidney and the parietes above, and extended downward for a considerable distance, although no attempt was made to trace it to the ureteral fistula. A drain was put in and no further steps were taken to expose the kidney, the enormous amount of inflammatory scar tissue suggesting that the finding of this organ and its liberation might be fraught with unnecessary risks.

Future Course.—The patient immediately made an *uneventful recovery. Within a few days the ureteral fistula below closed*, and the wound cleaned up rapidly and healed within a week.

Conclusions.—What were we dealing with in this most remarkable case? Was it a true ureteral fistula or was there perforation of the hydronephrotic kidney with escape of urine into the perirenal tissues, the urine dissecting its way down the retroperitoneal space? (Fig. 185).

The immediate closure of the abdominal urinary leakage after the lumbar incision lends credence to the following view, that *a perforation of the renal parenchyma or renal pelvis* had taken place, and that an exudate was present for several weeks both in the loin and in the lower lumbar region; that the lumbar drainage allowed the kidney sinus to close, there being *no* ureteral leak. The escape of urine through the abdominal incision was altogether due to urine that had dissected its way down from the kidney along the ureter, and thus out through the wound. The large amount of fluid encountered in the retroperitoneal tissues at the first operation was possibly more than serous fluid of edema, and was perhaps urine that had escaped from the kidney—an unusual but conceivable condition.

How else could we explain the fact that immediately *after*

the lumbar incision practically *all* of the urine entered the bladder, and the abdominal sinus became instantaneously *dry?*

Doubtless an opening (possibly a valve-like one) in the kidney or pelvis accounted for the persistent flow through the abdominal sinus, and so also the paradoxic situation of the synchronous drainage of 60 to 70 ounces of urine through the solitary ureter

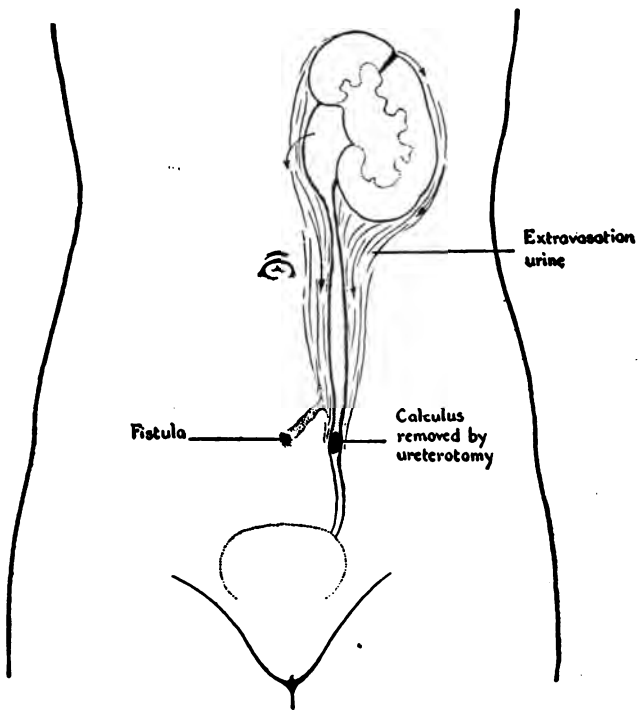

Fig. 185.—Diagrammatic representation of a distended kidney with dilatation of the pelvis and ureter, in a case in which a urinary fistula persisted by reason of the fact that extravasation of urine occurred as indicated.

and the copious escape of fluid through the abdominal sinus can be readily understood.

From there on the patient's recovery was uneventful.

(*c*) **Perforation of the Ureter.**—You will find this by far less common than similar lesions of the extrarenal pelvis or upper lumbar ureter. That penetration of the ureter either in its pelvic course or high up is not necessarily incompatible with

complete conservation of the urinary tract I may be able to demonstrate to you in the following beautiful instance of low penetration of the pelvic course of the ureter, and later on in an additional example of migration of a calculus from the lumbar ureter into a periureteral abscess.

D. A., female, thirty-two years of age, had been operated upon four years previously for some uterine trouble, and at that time her appendix was removed. She was catheterized after the operation; since then has had more or less trouble on voiding, with attacks of urinary frequency and pain in *right lumbar region*.

Two weeks ago she began to have very frequent attacks of colicky pain in the right kidney region, radiating to the right groin and thigh, associated with marked burning and urinary frequency, with voiding every fifteen minutes to one-half hour, and frequently during the night. There was some nausea and vomiting, but no marked rise in temperature.

On August 20, 1919 she was cystoscoped by someone, who is said to have found pus in the specimens from the right kidney, who met an obstruction in the right ureter, and who then proceeded to inject argyrol into the kidney (?) or ureter. Immediately thereafter the patient's temperature rose to 102° and 103° F., she was very sick, and on the 26th was admitted to a hospital in Brooklyn. A second cystoscopy was done, this being again followed by fever, chills, and *suppression of urine*.

When seen by me in consultation on September 1, 1919 she had had temperature for several days. There had been an attack of *convulsions* on August 31st, during which the patient was unconscious for half an hour, and there was a repetition of the convulsion on the morning of this day, no urine having been secreted for some twelve hours.

In short, in a patient who gave symptoms of right renal colic, who on cystoscopic examination seemed to have an obstruction in the lower pelvic ureter on the right side, and in whom on two occasions cystoscopy was followed by high temperatures and chills, who now was beginning to show the symptoms of urinary suppression, it was expedient to determine whether the intact organ was sufficiently healthy to permit of

operative intervention, to decide as to whether the patient was in condition for operation at all, and to make an exact anatomic diagnosis as to the existence of a calculus on the right side, since the *x*-ray examination already done had proved to be negative.

Cystoscopy, September 2, 1919: There was an obstruction to the passage of the ureteral catheter in the right ureter at a point 5 cm. removed from the bladder orifice of the ureter, no flow being obtained from the right kidney. A shadowgraph catheter was inserted. There was a rather scant flow from the healthy side (the left side), but a sufficient amount was collected to show that phenolsulphonephthalein was excreted.

Tentative Diagnosis.—Calculus in the right ureter at 5 cm.; inhibition of the function of the left kidney.

If you will follow me through the findings at operation, a number of interesting points will be developed for discussion.

Right ureterotomy for calculus in the ureter, *resection of perforated ureter, ureterorrhaphy.* September 5, 1919, through the usual pararectal incision, extraperitoneal exposure of the right ureter was made, the tissues about the pelvic ureter showing the usual evidences of a very intense periureteral inflammation, the ureter being firmly bound down to the peritoneum, and in the true pelvis surrounded by an inflammatory exudate, which was dissected away with some difficulty. Low down in the pelvis the ovary could be recognized firmly embedded and attached to the peritoneum, to which the inflamed ureter was adherent. In carefully dissecting out the ureter and separating off the peritoneum mesially, an inflammatory exudate with granulation tissue was encountered, and in it the torn, perforated ureter was seen to lie. The edges of the large rent, which was practically complete, were seen to be covered by reddish-brown, partly organized blood-clots, indicating that the ureteral rupture must have taken place some time in the past.

About 2 cm. below this ureteral tear the calculus was found firmly attached and incarcerated in the ureter.

The character of the ureter in the region of the tear is worthy of your attention. The ureteral wall was so friable and reddened and inflamed as to resemble the mucous membrane stripped

from out of the muscular coats of an inflamed appendix. Was this loss of continuity of the ureter beyond repair? No.

After the removal of the calculus the inflamed edges of the ureter were resected, about ½ inch of the ureter being sacrificed, the ureteral lumen enlarged by one small longitudinal incision in each end, and ureterorrhaphy accomplished with fine interrupted chromic catgut sutures. A rubber-dam drainage was applied, and suture carried out in the usual manner.

Future Course.—The wound healed nicely except for a fistula that was established at the lower end, at the site of the drainage, leakage of urine being continuous for fourteen days, when I decided to attempt to insert a ureteral catheter.

For, let me emphasize, it is the cystoscope with the retention ureter catheter that you will have to resort to, wherever you believe that a renal or ureteral fistula is perpetuated by a removable obstruction peripherally situated—be that obstacle an actual body (stone) or merely swollen mucous membrane.

Therefore, on September 16th cystoscopy was done, but an insurmountable obstruction was again met with at about 5 cm. from the right ureteral orifice, so that our very slight hope of obtaining ureteral union seemed almost shattered.

On October 4, 1919 it was decided to make another attempt to close the ureteral fistula by the insertion of a ureteral catheter, and, to my gratification, it was easy to pass a catheter into the right ureter. Its introduction was followed immediately by a very copious flow of cloudy urine, containing numerous pus-cells. The catheter was allowed to remain *in situ* about four days. Immediately after its insertion the abdominal fistula ceased secreting urine, and bid fair to close.

After the removal of the catheter on October 8th no leakage occurred through the abdominal sinus.

On cystoscopic examination October 9th no obstruction was encountered in the right ureter, and, although some retention of urine was demonstrable in the kidney, it was much less in amount. The urine was practically clear, save for an occasional pus-cell. The pelvis of the kidney was irrigated with silver nitrate. The abdominal sinus was evidently closing.

From now on the abdominal sinus remained closed, and the patient was discharged on October 15th, the wound healed, the function of the right kidney having been found actively functionating, and the normal patency of the ureter having been established.

On October 23d the patient returned to the office for another cystoscopic examination. No retention of urine was demonstrable in the right kidney, the urine being practically clear.

Summary.—The vitality and healing power of the ureter are amply shown in this case, where even in an inflammatory field the ureteral continuity had been re-established after resection. At any rate it has been demonstrated that not only should an attempt at ureteral anastomosis be made in such cases, but that the ureteral retention catheter is of great value in causing closure of a ureteral urinary fistula.

(*d*) **Perforation of the Ureter (with Abscess).**—Although this is not a common occurrence, several cases have come to my notice during the last ten years. Here is a man in whom perforation of the ureter with ureteral abscess is not an unlikely diagnosis, since he has just had an acute attack of lumbar pain, fever and chills, marked rigidity and tenderness, and has an obstruction which corresponds in the *x*-ray plate to a stone about 2 inches below the renal pelvis. A differential diagnosis between acute pyelonephritis, multiple abscess, retention of pus in the kidney, suppurative infarction giving rise to temperature, and some or none of these lesions associated with periureteral abscess cannot be made. It is interesting, however, to note that in spite of spontaneous rupture of the ureter healing can take place without suture, but with merely the removal of the offending calculus and drainage of the infected kidney.

Bilateral Lithiasis with Bilateral Renal Infection; Ureteral Blockage by Stone; Periureteral Abscess; Perforation of the Ureter; Nephrotomy; Removal of Calculus; Decapsulation and Recovery.—The patient I am showing you today (A. A.) has had a long history of trouble in both kidneys due to calculi of the phosphatic variety and infection. He has passed stones from both kidneys. He has been kept under observation from May

24, 1919 until today, November 25, 1919. During this time calculi were removed from the bladder through the operating cystoscope, some were crushed; this right kidney was drained through the ureteral catheter on two occasions because of retained purulent urine, these manipulations having given him immediate relief. About five months ago he still had two stones in the right kidney; he had one stone in the right kidney about $\frac{5}{16}$ inch in diameter lying in the lower portion of the pelvis.

It is this stone that is now giving him trouble.

For several days, particularly for the last two or three days, he has had intense ache in the right lumbar region, chills, fever, exquisite tenderness in the region of the back and the kidney, and frequent urination. He feels so sick that he seeks relief.

Cystoscopy shows an obstruction at 25 cm. in the right ureter, and this cannot be overcome; no urine can be obtained from the right kidney.

Conclusions.—We must diagnosticate impaction of the ureter calculus in the upper ureter, $1\frac{1}{2}$ to 2 inches from the kidney, and this assumption is confirmed by the *x*-ray examination.

Operation. Removal of the Ureteral Stone, Nephrotomy, Decapsulation, Drainage.—I am cutting through the perinephritic tissues which you see are enormously increased in thickness; the part is edematous; contains exudate; and the fluid is so large in amount that it is possibly urinous? I am now attempting to feel the calculus at the site indicated by cystoscopy and *x*-ray, and find a large exudate adherent to the posterior abdominal wall. As I separate the inflammatory tissue about this exudate you see this sudden escape of about 1 ounce of thick pus, indicating the existence of a periureteral abscess, due to perforation of the ureter. Here is the stone which has caused the trouble.

I must not be content with this procedure alone, but the kidney must be drained, since it is badly infected, and I am, therefore, making a small nephrotomy opening for the insertion of a tube drain. Decapsulation too must be done, since minute abscesses will escape observation and restitution of the kidney cortex after stripping of the capsule will take place more readily and with more certainty.

The region of the perforated ureter is drained with a rubber-dam and a small tube.

The kidney incision is drained in the manner found best for infected cases.

Subsequent Course.—This patient made an uneventful recovery.

A subsequent cystoscopy in 1920 and 1921 demonstrated that complete restitution of the ureter had taken place in spite of the fact that no suture had been done, and in spite of the large hole in the ureter which the perforation had occasioned.

V. POTENTIAL PERFORATIONS

(*a*) **Potential Perforations of the Kidney.**—I shall merely mention some of the lesions you may meet in your operative work as follows:

1. Closed cortical leaks in hydro- or pyonephrotic kidneys, or acutely distended kidneys with ureteral or ureteropelvic blockage. In such you may find urine and pus in the perirenal tissues, but the opening has become sealed off (Figs. 179, 180).

2. Potential leaks, so that the separation of the perirenal adhesions establishes a communication with the renal pelvis (Figs. 179, 180). Infarctions of suppurative or ischemic variety occasionally belong here.

3. Actual subcapsular perforation with subcapsular accumulations of fluid (Figs. 181, 182).

(*b*) **Potential Perforation of the Pelvis with Ureteral Stricture.**—We speak of potential perforations of the pelvis as being those which we are able to discover by operative exposure during the period preceding actual rupture, and before extravasation of urine has occurred. That such a stage exists quite a number of clinical examples have taught me.

These potential perforations are defects in the pelvis that have been covered or sealed off by protective peripelvic inflammatory tissues. Thus, we see them occur with ureteral stricture either in the upper lumbar ureter or in the pelvis. Such may be complicated by calculus or may have been produced

by a calculus that had previously passed. Associated with such strictures there is apt to be a chronic non-virulent (sometimes called subacute) pyelonephritis with more or less dilatation of the pelvis. The extrarenal pelvis may become enveloped in a brittle inflammatory envelope, which is a protection in that it makes a sort of pseudosheath that substitutes for the eroded and disintegrated ureteropelvic tissues. So extensive may the destruction of the upper ureter and pelvis be in such cases that considerable resection of both of these structures may become necessary when operative procedures are carried out. That considerable loss of tissue is well sustained, and that plastic reconstruction of the ureteropelvic junction is a surgical procedure attended with success even in the presence of such infection, I shall point out to you in the demonstration of the following most interesting case.

In a previous clinical lecture, a case of resection of a similar lesion in the lower ureter with plastic end-to-end apposition of the ureter, was seen to have had a successful issue. Here, too, a potential perforation of the pelvis with rehabilitation of the upper portion of the urinary conducting system prolonged the viability of a kidney much damaged by a previous operation and inflammation.

Chronic Pyelonephritis; Bilateral Renal Infection; Ulcer of the Bladder; Potential Perforation of the Pelvis of the Right Kidney; Resection of the Pelvis and Upper Ureter with Plastic Reconstruction, with Complete Restitution of the Upper Conducting Mechanism.—This middle-aged woman is one of those bad examples of impairment of function of both kidneys due to the untoward effects of chronic infection and mechanical factors, in which much could have been accomplished by the more timely application of modern urologic methods. You see her here today with both kidneys the seat of a chronic pyelitis, with an ulcer in her bladder, a chronic cystitis, and a stricture in the upper right lumbar ureter.

She says that she has had both kidneys "fixed up" (nephropexy) some eleven years ago; since then has been suffering great kidney pain, particularly in the right side, radiating down into

the region of the navel. For the past three years her bladder too has been giving her considerable trouble, with increasing urinary frequency.

Let us pause for a moment to consider the question as to why this woman has had pain since her operation. Although it is difficult to come to accurate conclusions and my theory may not appear to you convincing, nevertheless, let me impress upon you that none too infrequently have nephropexies been done in the past on cases of renal infection, particularly when cystoscopic diagnosis has not been properly applied. It would appear to me more likely that this woman had been suffering from a chronic pyelitis with or without stone, for the lesions, I shall demonstrate to you, would seem to bear me out in this contention.

Having cystoscoped this woman upon one occasion, and having found an obstruction in the right ureter at 20 cm. from the bladder, with, however, an abundant urinary flow containing considerable pus, with purulent urine from the other kidney, and without any putput of indigocarmin from either side during a period of one-half hour's observation, you will doubtlessly be rather averse to the immediate induction of an operative procedure, when you know that both kidneys are not only obstructed but poorly functionating.

Make it a general rule that whenever an obstruction is met in the ureter on one occasion, and the *x*-ray examination—as here—shows no calculus to account for it, and when the surgical indications are not clear, to consider most strongly the advisability of subsequent confirmatory cystoscopic examination.

And so here we will cystoscope again, in fact, if necessary more than once, for confirmatory and further corroborating information. Our second and third cystoscopies demonstrate again this same obstruction in the upper lumbar ureter with a flow of purulent urine when the catheter is tightly wedged against the obstruction. What shall we surmise from these findings? That there is a stricture in the upper lumbar ureter; that the eye of the catheter gets beyond it and empties the pelvis of the kidney which is dilated; that there is a chronic infection of the pelvis, possibly a pyelonephritis; that there is an obstacle to the out-

flow in the centrifugal sense, *i. e.*, from the kidney downward and outward to the bladder, which is an insufficient barrier to the outflow of urine, and that there is a complete obstruction in the centripetal sense, so that the catheter will not pass into the intrarenal pelvis.

Having determined by cystoscopy that it is the right kidney which is giving the patient the most trouble, that there is a left-sided pyelitis, but that the mechanical obstruction in the right ureter is responsible for many of the patient's symptoms and will doubtless jeopardize the integrity of the corresponding organ, it behooves you to determine whether she will withstand a severe surgical procedure. And, second, you will endeavor to determine, even before taking the knife in hand, as to whether you wish to conserve the kidney or not.

For the determination of the first point, the phenolsulphonephthalein test and the blood chemistry are of value. And so here we find that the total output of phenolsulphonephthalein in two hours is about 44 per cent.; and the blood chemistry shows but a slight increase in urea nitrogen and creatinin. The figures are not high enough to contraindicate operative procedure.

In all cases of pyuria where stone cannot be demonstrated in the *x*-ray we must not fail to exclude tuberculosis, and so here careful search was made with negative findings. Indeed, the culture showed the Bacillus lactis aërogenous capsulatus a not infrequent invader of the urinary tract.

Plastic Repair for Potential Renal Pelvic Perforation.—If you will follow me in my operation on this right kidney, as I go through the scar tissue and the adhesions consequent upon the previous nephropexy, you will see here below, along the inner border of the adherent kidney, a mass of fatty inflammatory tissue reaching to the pole, occupying the lower third of the mesial border (Fig. 186, *A*). As I separate this inflammatory fat to expose the ureter and ureteropelvic junction, it is evident to me that there is an encasement of the pelvis and upper ureter with such dense tissue as to produce a veritable contracting sheath, whose influence must, I surmise, be of significance not only in its mechanical effect upon the ureter and pelvis but also

in its protective influence upon the alterations that are going on within.

Do not be surprised, therefore, if I should disclose a tear or a perforation in the ureteropelvic junction as I retract, for it is in this region that I suspect the stricture to lie, and it is here that the renal pelvis may be attenuated, corroded, friable, and perforated. You are not surprised, therefore, that in opeing the ureter, as the last piece of inflammatory fat is gently pulled aside, to note the outflow of retained purulent urine from the kidney.

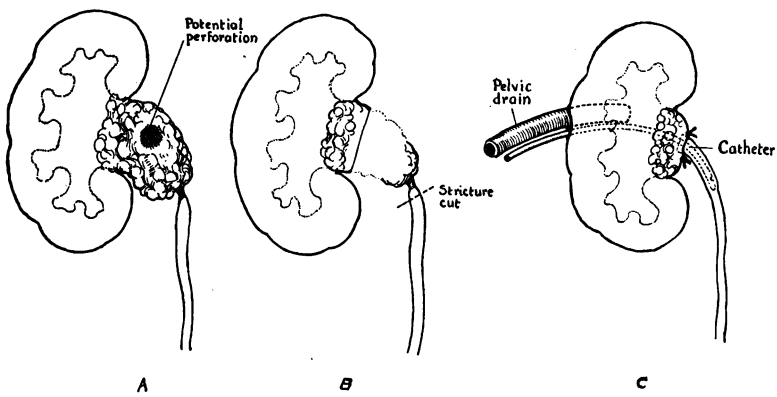

Fig. 186.—Diagrammatic representation of the conditions in this case: *A*, Potential perforation is indicated; central picture (*B*) depicts resection of the degenerated portion of the pelvis and the stricture is indicated; on the right (*C*) pelvic drain inserted, ureter drawn into the pelvis, invaginated, and held by suture; catheter emerging alongside of the pelvic drain acts as a stay for the ureteropelvic anastomosis.

Let us now inspect these tissues. The pelvic mucous membrane is angry red, inflamed, very brittle, the outer coat being evidently destroyed, and it appears to me that the upper ureter will be found to be similarly compromised. I hear the question asked "Why continue stripping off this peripelvic inflammatory tissue, whereby you may jeopardize still more of the tissues?" My answer to this is, "Look back at your history and the findings at cystoscopy." Did we not obtain distinct evidences, on three occasions, of a ureteral stenosis, of retained urine in the kidney? Is not this woman suffering from pain—pain not due to infection

alone, but due to a mechanical obstruction, dilatation of the kidney? Was not this kidney demonstrated in the *x*-ray to be enlarged?

And so it behooves us to explore and relieve this obstruction, if necessary to resect and sacrifice that portion of the canalicular system whose lumen has been coarcted, and whose function as a conducting mechanism is no longer adequate.

And so I shall explore the ureter with a probe, and you see as I enter it the very smallest silver probe cannot enter the lumen of the ureter. This should be sufficient evidence of the correctness of our indications.

Lay open longitudinally this stenosed upper ureter with a fine scissors until we reach the healthy ureter about 1 inch below the perforated pelvis. With these tissues now patent and presenting before you, there can be no doubt in your mind that they can no longer be employed as a reliable wall for the collection of a urinary secretion. We shall, therefore, mobilize the upper ureter to see whether it can be brought upward to meet the pelvis higher up, and now it is evident that this can be accomplished. Let us cut transversely through the healthy portion of the ureter and excise all this friable, inflammatory, unhealthy, ureteropelvic tissue (Fig. 186, *B*). Now we have a hiatus of about 1 inch with very little pelvis to which to sew this ureter. End-to-end suture will be impossible, as you can see, so let us, therefore, make a longitudinal incision into the ureter so as to increase its girth, and draw it upward by a process of invagination into the pelvis. Before doing this, however, let me feel more confident of the result of my plastic operation by making a small opening in the cortex of the kidney and introducing a small catheter (No. 12 Fr.). Now I introduce it into the upper ureter (Fig. 186, *C*), while I draw fine chromic stiches upward and sew them to the pelvis.

As a further safeguard, I insert a small drainage-tube into the infected pelvis of the kidney to the cortex alongside of the small catheter so as to combat the renal infection, and to insure further healing of our plastic operation (Fig. 186, *C*).

After-course.—I am presenting this case to you just fourteen

days after operation. The small catheter was removed on the eleventh day, the larger tube on the thirteenth, and today you see that the wound is healed and that there is no leakage, although a small aperture still exists.

Comment.—This patient was examined again on June 17, 1919. Cystoscopy demonstrated that the plastic operation was a success, as there was an absence of obstruction, good flow of urine obtained from the right side, and no evidence of hydronephrosis.

Again on August 4, 1920 cystoscopy showed the absence of stricture.

(*c*) **Potential Perforations of the Renal Pelvis.**—*Pelvic Erosion Due to Stone.*—While occasionally in the neglected case you will be called upon to operate when the stone has migrated through the ureter or pelvis, when a periureteral abscess or extravasation of urine is present, there are milder or so-called subacute cases, characterized by a long period of lumbar ache with pyuria, without severe attacks of high temperature, in which erosion of the pelvic wall by contact with a rough stone, plus the influences of infection, have brought about a potential perforation, protected by periureteral, inflammatory adherent tissues. Such eventuality is most apt to be the complication of the lodgment of the spearhead, triangular, pyramidal rough type of calculus, as I show you in this diagrammatic drawing (Figs. 187, 188). So I may exemplify my thesis in bringing to your notice this interesting case of a woman with a long history of lumbar ache and pyuria.

Fortunately, it is just these cases that demonstrate the viability of the pelvis of the kidney, its great resistance to operative procedure, and its great power of healing and restoration after plastic operation. Conservatism, therefore, and plastic repair of the urinary channel shall be your guiding motives in the treatment of these conditions.

Potential Protected, Renal Pelvic Perforation Due to Calculus; Plastic Closure, Recovery.—This stout woman (L. C.) upon whom I am about to operate (January 14, 1920) has had pyuria and lumbar pain. She has had a cystoscopy performed, and an

fatty masses and calculus. In truth, you will often be disappointed at your seeming inability to differentiate the two; and it may be necessary to separate much inflammatory fat about a renal pelvis before your effects at palpation will be of diagnostic value.

If you look at the pelvis that is presented to you now, you will see that its normal markings are altogether absent, an irregular mass of lobulated fat and inflammatory adhesions binding the

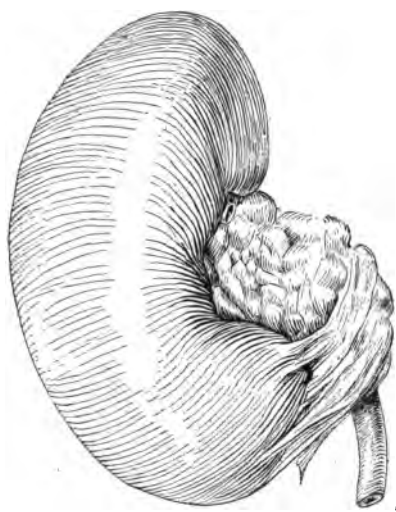

Fig. 189.—External view in the case described where marked peripyelitis is represented by inflammatory fat surrounding the pelvis, with bands of adhesions about the ureteropelvic junction, concealing the potential perforation at the kinked portion of the ureteropelvic junction.

upper ureter to the lower pole of the kidney, the fatty lobulations passing over the kidney and causing an apparent angulation just above the site of the ureteropelvic junction (Figs. 189, 190). At the mesial wall of the pelvis above the ureteropelvic junction a hard body projects; and it is here that care must be exercised lest a large tear is produced in my exposure of the pelvis. As the adhesions are separated a pointed part of the calculus all but emerges through the pelvic wall (Fig. 191). Now I am

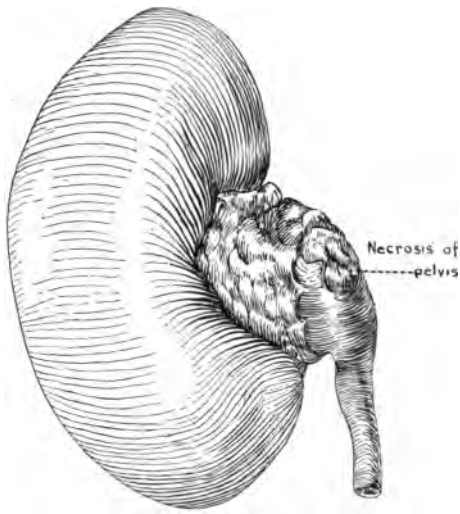

Fig. 190.—Site of necrosis of the pelvis after the removal of some of the adhesions.

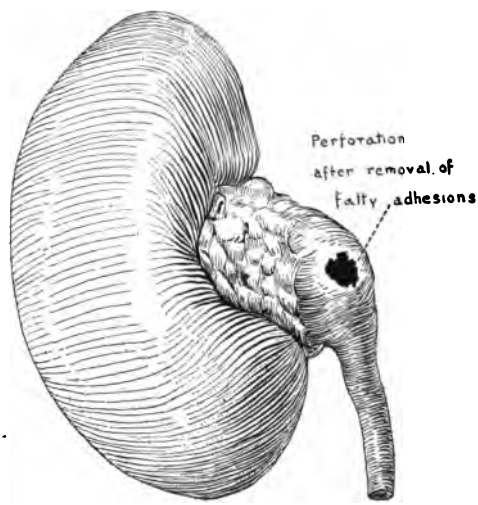

Fig. 191.—Demonstrates the ragged opening in the pelvis with prong of the calculus jutting through the pelvis.

lifting up the ureter, which is thickened, red, swollen, and dilated, and a sharp prong of the stone penetrates the adhesions

covering a potential perforation, and there is an escape of some bloody urine. I am now enlarging the opening in the kidney so as to extract the calculus, which is delivered easily and appears to measure about ¾ inch in diameter. Because of the dilatation of the pelvis my finger can be easily introduced to find concretions in the lower pole. Because of the evident infection a buttonhole nephrotomy near the lower pole will be made. This is now carried out without hemorrhage, the concretions are removed, and drainage will take place through the nephrotomy opening rather than through the pelvis.

Closure of the Renal Pelvis.—When the tissues in the pelvis are as friable as here you must resort to the inclusion in your fine chromic gut sutures not only of the perirenal tissues, but at times also of the capsule of the kidney, near the hilus. This gives a good support. You may also draw the ureter upward somewhat, passing a stitch through a healthy portion and anchoring it higher up; and thereby broaden a narrow compressed pelvis in typical plastic fashion.

To demonstrate that the ureteropelvic junction has not been infringed upon by my sutures I am passing this long probe through the cortex into the pelvis, and down into the ureter. The suture line in the pelvis need not be drained, but a piece of rubber-dam will be placed down to the region in the immediate proximity of the pelvis, while a small rubber tube will remain in the buttonhole nephrotomy for about six or eight days.

Future Course.—This patient made an uneventful recovery. There was no urinary leakage from the extrarenal pelvis, drainage being altogether through the nephrotomy tube; the wound healing by primary union.

A subsequent cystoscopy demonstrated that the patency of the ureter had been re-established.

CLINIC OF DR. WALTON MARTIN

ST. LUKE'S HOSPITAL

TUBERCULOSIS OF THE LYMPHATIC VESSELS OF THE LEG AND OF THE SECOND METACARPAL BONE. SECONDARY ELEPHANTIASIS

Clinical History and Previous Treatment: First Operation, Amputation of Thigh; Second Operation, Excision of Lower Third of Metacarpal. Comments. Prognosis.

THE patient, a male Italian, is seventeen years old. When four years old a small soft swelling was noticed near the base of the second toe of the right foot. This was opened. The incision did not heal; it continued to discharge small amounts of cheesy, purulent material. In the course of the next ten years similar swellings, following a similar course, appeared between each of the toes of the foot. The ankle gradually became swollen, and about three years ago the leg began to enlarge. A row of soft nodules formed, softened, burst through the skin or were opened on the dorsum of the foot, on the inner side of the ankle, and in a number of places along the leg, and finally in the popliteal fossa. From time to time the leg and foot became much swollen and red. During these attacks he had fever, lost his appetite, and felt sick. The discharge from his leg has varied; at times it is semipurulent, at other times it is very thin and profuse.

I first saw him two years ago. He was brought to me by one of the workers in the Social Service. He had been going about from clinic to clinic having softened nodules opened and indolent sinuses cureted. The diagnosis had usually been, I believe, chronic osteomyelitis.

The examination I made at that time was negative except for

the right leg; no lesion of the lungs, bones, or joints was detected. The inguinal lymph-glands were slightly enlarged; several could be felt about 1 cm. in their longest diameter. The leg from the knee down (Figs. 192, 193) was greatly enlarged. The dorsum of the foot and ankle was swollen and cushion-like.

Fig. 192.—Anterior aspect of leg.

Fig. 193.—Posterior aspect of leg.

The swelling did not pit on pressure; it was rather firm and elastic. There were a number of small ulcerating areas between the toes, on the dorsum of the foot, and along the back of the leg; and there was a sinus in the middle of the popliteal fossa. If you examined closely these ulcerating areas you saw that they

had undermined livid edges, and that the base was formed by watery, boggy granulations; a thin, cheesy pus was oozing from some, on others the secretion had dried into a brownish-yellow crust. On lifting up one of these crusts a thicker secretion could be seen exuding from the ulcerating surface. The knee-joint movement was free up to nearly complete extension, then there was a somewhat yielding limitation of motion. He had been holding his leg slightly flexed ever since the opening of the sinus in the popliteal fossa.

A probe passed gently into any one of these granulating areas demonstrated not only the overhanging skin borders, but found its way readily into a long sinus, extending apparently beneath the skin. I had *x*-ray plates made of the foot, leg, and thigh. They showed no lesion of the bones (Fig. 194).

The appearance of the small ulcerations and broken-down nodules, their curious linear arrangement in the long axis of the leg, the fact that the probe passed in each instance subcutaneously—not into the deeper tissues—and the obvious interference with the lymphatics making the elephantiasis-like swelling of the leg, made me think that the young man was suffering from a very rare condition—tuberculous lymphangeitis. I had once seen a patient with a similar lesion on the arm, and was familiar with the description and plates given by Jordan and referred to in Lexer's General Surgery and in Hildebrand's revision of Koenig's Surgery.

I had a small piece removed from the margin of one of the ulcers. When examined under the microscope it showed the typical lesion of tuberculosis. The ulceration about the toes seemed to me the starting-point of the attacks of secondary infection, so I advised and carried out amputation of four toes. I then laid open several of the subcutaneous tracts. To my surprise, they were far more extensive than I had supposed, and communicated with one another. A probe could be passed readily from the sinus in the back of the leg and made to emerge from the sinus in the popliteal fossa, fully 5 inches away. They were lined with flabby, watery granulations.

The amputation wounds healed and the skin over the sinuses

healed, but, obviously, a far more extensive extirpation was necessary.

About a month ago, however, he began complaining of his right hand, in the region of the second metacarpal. An *x*-ray

Fig. 194.—*x*-Ray of leg to demonstrate: (*a*) Normal bone; (*b*) thickened soft parts.

plate showed an obvious lesion. I then advised amputation of the thigh, as he evidently had a blood-stream infection and was beginning to have multiple foci. He, however, refused at first, but has finally consented on account of his increasing disability.

As you can see, he now has a sinus over the head of the second metacarpal, and a probe passes into a cavity in the bone. This morning I am going to amputate his thigh. When the stump has healed I am going to resect the second metacarpal. Both operations must be done in a contaminated field. It is obviously difficult to sterilize the skin of the leg, and I must leave as long a thigh stump as possible. This will carry the skin incision near this uppermost sinus (a new one has formed just above the knee). It is for this reason I have decided to do the operations one at a time.

First operation, June 10, 1920: I am using nitrous oxid gas and oxygen as an anesthetic. The foot and leg are bandaged with sterilized material and the thigh is painted with iodin, including the mouth of the last sinus. I use the method of Lister for insuring a bloodless field—I have the leg elevated for three minutes. When the tissues become blanched from spasm of the arteries I apply a constricting rubber bandage. Obviously, it would be undesirable to apply an Esmarch from the foot up; tubercular bacilli from the infected area might readily be forced into the circulation. I shall use the flap method, making my longer flap on the side away from the sinus, thus gaining as long a stump as possible. You see, as I cut through the skin, that there is almost no bleeding and that the derma and subcutaneous tissue at this point are somewhat thickened. As I make my short postero-internal flap I am passing through pathologic material. I have opened a tunnel lined with flabby granulations. The process in the lymphatics has extended higher than I supposed. I will, therefore, change my incision and make my amputation 3 inches higher. Now I am going through tissue that is not obviously altered. There is nothing abnormal to be noticed as I cut through the muscles or saw through the bone. I am severing the periosteum flush with the cut surface of the bone. The vessels are ligated; the large nerves are pulled down, excised, and the trunks injected with absolute alcohol. The constricting bandage is removed; the moderate bleeding from the muscle branches is stopped. The muscles are brought together in the usual way with interrupted catgut sutures and the

skin with interrupted silk and horsehair. I am taking great pains to get exact skin apposition. I introduce two rubber tubes in the angle of the wound and apply heavy gauze dressing.

Second operation, September 21, 1920: The patient has gained 15 pounds. The amputated leg showed linear tracts of tuberculosis extending as tunnels in the subcutaneous tissues. He had almost no reaction following his amputation and astonishingly little pain and discomfort. The stump has healed soundly except for two small areas about the size of the head of a pin, along the line of incision, which are covered with crust. On removing these crusts a small ulcer is found under each. They look like small tuberculous lesions. They are very superficial, however. There is no sinus, and I believe they will readily heal after cauterization.

I am again using nitrous oxid gas and oxygen anesthesia. I do not now need a bloodless field. I am going to cut through the sound portion of the second metacarpal and remove the distal portion containing the tuberculous focus. I make my incision circumscribing the mouth of the sinus and then extend it distally along the line of the metacarpal. With the knife I cut away the soft parts just external to the periosteal covering. When I have established the right plane, I insert a blunt periosteal elevator beneath the sound proximal portion of the metacarpal about ½ inch from the diseased portion, introduce a Gigli saw, and divide the bone. I now lift up the bone distally to the division with forceps, and then with a sharp knife sever the tissues about the bone as they are put under tension. When I reach the joint I divide the ligaments and remove the infected bone without having cut through any diseased tissue (Fig. 195).

I put a small amount of iodoform powder into the cavity after the removal of the bone. This dead space will fill up with blood, and blood—although when first shed it is bactericidal—soon becomes an excellent medium for the growth of microorganisms. The iodoform will not kill bacteria, but in the presence of blood-clot will keep on liberating iodin—as you can easily prove by testing the urine tomorrow—and will thus make a less satisfactory pabulum for bacterial growth. I once poi-

soned a man by introducing a considerable quantity of iodoform after resecting a hip. He had delirium, high fever, and a very

Fig. 195.—Resected end of metacarpal divided longitudinally after removal to demonstrate: (*a*) Bone cavity; (*b*) bone cavity with sequestrum.

rapid pulse. The clinical picture resembled hyperthyroidism. He recovered, but since then I have been careful not to introduce very large amounts.

I shall close the wound with a few interrupted horsehair stitches. I prefer not to drain after excision of a tuberculous lesion, if possible. The wounds seem to heal better and with less tendency to a persistent secondary infection if a track is not established into the deeper tissues. I put the hand up in a light plaster-of-Paris dressing. I shall watch the temperature. If there is temperature or much pain I shall remove the plaster and take out the stitches.

Comments.—Although tuberculosis of the lymph-glands is so common, and although tuberculosis of the lymphatics in the lung and in the mesentery is well known, this lesion is a very unusual one. Possibly it is due to some special way in which inoculation occurs; possibly, to a secondary infection and consequent obliteration of the lymph-vessels which made the walls vulnerable and easily affected.

It is interesting that during fourteen years the lesion was confined to one extremity; then it finally reached the blood-stream and caused a metastatic lesion. Did the preliminary operation and incision cause this? The patient could have been readily cured of his disease in the beginning. Simple excision of the original focus or of the early secondary foci would have sufficed. Incision and cureting is a very unsatisfactory method of treatment for local tuberculosis. Complete excision is very satisfactory. When the curet is used, the superficial granulations are removed, but the tubercles that lie deeply embedded in the organized connective tissue, making up the outer wall of the lesion, are untouched. Simple incision almost invariably leads to secondary infection and advances rather than retards local disease.

Originally I had hoped to get the leg free enough from secondary infection to be able to excise the entire tuberculous tract with the deep fascia—doing, as it were, a Kondoléon operation and at the same time removing the diseased tissue. The extent of the secondary infection and the metastasis made me abandon this idea.

I believe the prognosis is good. The young man has already gained 15 pounds since his amputation, besides the weight of the leg removed. He looks and feels well.

CLINIC OF DR. FORDYCE B. ST. JOHN

FIRST SURGICAL DIVISION (MEDICAL DEPARTMENT, COLUMBIA UNIVERSITY), BELLEVUE HOSPITAL

EMPYEMA

THIS morning I shall present to you selected cases of empyema from our Follow-up Clinic. These cases have been selected from our empyema series to illustrate, first, problems of diagnoses and treatment and method of meeting these problems; second, the bacteriologic and pathologic findings, with their significance; third, complications as they arise during the course of an empyema; fourth, errors in judgment on our part, with a careful analysis of these errors and unsatisfactory results; and lastly, to emphasize the care in the postoperative treatment which is absolutely essential to consistent success in treating patients with this disease.

Last week you saw in this clinic the operative procedure employed in cases of empyema, and several cases still in the hospital illustrating phases of the immediate postoperative treatment, with emphasis on Carrel-Dakin technic. Today the patients whom you will see have been discharged for from several months to one and a half years. They will be shown with a summary of the history, physical examination, roentgenologic findings, bacteriologic factors, pathology at operation, and finally with a résumé of the course, the condition at time of discharge, and later follow-up visits.

For the last year and a half the series comprises 40 cases. Of these, 9 are cases of abscess of the lung without empyema, 5 are cases of abscess of the lung with empyema, leaving 26 cases of empyema of the acute and chronic type. It is of these cases which I wish to speak today, inasmuch as we will consider abscess of the lung, with and without complications, at another time.

Of the total number of cases of empyema, uncomplicated by abscess of the lung (26), 2 have died, or a mortality of 7.5 per cent.

An analysis of these deaths shows the following: The first case was an acute streptococcus empyema, admitted to the medical service with a temperature of 105° F., pulse 120, and respiration of 36, with a bilateral pneumonitis. He was transferred to the surgical side in a moribund condition, and because of his type of infection, and profound degree of sepsis, we simply aspirated the right pleural cavity and removed 850 c.c. of typical streptococcus seropurulent exudate. He died fourteen hours after his admission, and the postmortem examination revealed, besides the suppurative pleuritis of the right side and an atelectatic lung, an extensive bronchopneumonia of the streptococcus type involving the other lung. There was also a seropurulent pericarditis.

The second case, a woman of thirty-four, was originally admitted to the Department of Laryngology with edema of the larynx as a result of advanced syphilis, which had necessitated a tracheotomy, and upon admission a tracheotomy tube was in place. After strenuous antisyphilitic treatment for six months a streptococcus pneumonia suddenly developed, followed by suppurative pleuritis, and after repeated aspiration, showing Streptococcus hemolyticus in the medical service, she was transferred to us with the tracheotomy tube still being used.

Under local anesthesia a partial ostectomy of the eighth rib, with drainage, was performed, and 1000 c.c. of thin, greenish-yellow, purulent exudate, with flakes of fibrin were removed. She died three days after admission to the surgical service, and I feel that in this instance repeated aspiration would have been wiser for some time longer rather than operative procedure, as her general condition was very poor, her breathing very labored and aggravated by the laryngeal involvement and her degree of sepsis. It is extremely doubtful that her life could have been saved under any condition, but I feel the operation was contra-indicated, considering all the circumstances. Unfortunately, permission to perform an autopsy could not be obtained.

Of the remaining cases, 24 in number, 8 are now in the hospital, and 16 have been discharged.

Of these 16 cases, 15 were discharged cured, and 1 was sent to the country as "improved," to remain until such time as a secondary operation would be deemed advisable for closure of a sinus. Although there was no evidence of a dead space, a sinus tract had persisted, and we felt it wise to give him the benefit of several weeks under ideal surroundings before performing the second operation, inasmuch as he had already greatly improved after a decortication and Carrel-Dakin treatment.

He failed to return, and as we have traced him to another hospital, where he was admitted for a revisional operation, we consider him as an unsatisfactory result on our records. He is now in Arizona, and as yet we have been unable to find out his present condition.

Of the 15 remaining cases, all of which were discharged healed, all have been followed:

1 was discharged sixteen months ago.
2 were discharged fourteen months ago.
3 were discharged ten months ago.
5 were discharged nine months ago.
2 were discharged eight months ago.
1 was discharged two months ago.
1 was discharged three weeks ago.

And all have remained well to date.

None of the cases of acute empyema which we have been able to follow from the onset of the disease have become chronic, although several have presented during their postoperative course potentialities of chronicity. This you will find is the experience of most surgeons who are interested in this problem, and for this reason, as Martin brings out in his paper, "The Etiology of Chronic Empyema," it would seem as if, in all probability, there is nothing inherently present in most acute empyemata, which is a prime factor in causing chronicity, but rather in the operative and postoperative treatment of the condition.

A word or two concerning the mortality in this series. It is important to remember that 7.5 per cent. mortality excludes the 5 cases complicated by abscess of the lung. Were these additional cases included our mortality would be 12.8 per cent.

The first case for demonstration is a woman of twenty-seven, married, with one child seven years old, who came to us with the following history:

About four weeks before admission she began suffering with headache, slight cough, pain in her chest, and sore throat. After two or three days, because of prostration, she went to bed and called a physician. Two days later the cough became worse and the patient's sputum became blood tinged. The physician made a diagnosis of pneumonia, and after treating her for ten days, during which time she seemed to become worse, on his advice she was sent to a hospital.

Soon after arriving at the hospital she says that the doctors "tapped her chest on the right side and drew out some pus," and that several days after that she was "operated upon and her right chest drained." That was about ten days before she was transferred to us.

Upon admission here, although feeling distinctly better, she complained of weakness and shortness of breath and presented a discharging sinus. Her general appearance was that of a "poorly developed, very thin and emaciated young white woman, lying quietly in bed, slightly dyspneic, not cyanotic, and apparently acutely ill."

Physical examination of her chest revealed limitation of expansion on her right side, a thoracotomy wound, 7.5 cm. in length, 4 cm. wide over the eighth rib in the posterior axillary line. The surface of the wound presented a greenish, sloughing membrane. Two rubber tubes 1 cm. in diameter were in place in a sinus of about the same size, and the dressings were soaked with thick, greenish pus. The percussion note was tympanitic below the sixth space posteriorly and dulness existed above anteriorly and posteriorly.

Anteriorly, breath sounds were harsh. In the region of the wound breath sounds were markedly diminished, but bronchial in

character, and posteriorly, throughout the entire chest, breath sounds were much diminished. No râles heard. Right chest, especially lower portion, was tender to percussion.

The left side presented resonance throughout, with breath sounds somewhat harsh, and a few subcrepitant râles were heard at the base.

Her temperature upon admission was 101° F.; pulse, 110; respiration, 24.

Blood count: 14,200 leukocytes, 81 per cent. polymorphonuclears, 19 per cent. lymphocytes.

Smear and culture from sinus tract showed a short chain streptococcus.

The Roentgen-ray examination, as you will see from this plate, showed these things: The pulmonic fields are of unequal size, the right being larger than the left, the illumination is brilliant throughout most of the right pulmonic field. The costophrenic sinuses are clear, and you will note that the outline of the diaphragm is visible, but that the right dome is somewhat depressed or flattened.

The heart, although normal in outline, is considerably displaced to the left, and the right lung, the outline of which you may see here, is almost completely collapsed. You will note here the resected ends of the rib and the two drainage-tubes *in situ*, directed upward and inward.

Now, with this data before us, what was the situation? Here was a patient, acutely ill, having presumably had pneumonia complicated by empyema, which two weeks before had been drained in the traditional manner at another hospital, and now came here draining profusely. She presented characteristic signs, with an open pneumothorax, and typical "dead space" which was infected, with a right lung markedly collapsed and not expanding.

Obviously, her mediastinum covered with plastic exudate and fibrin was immobilized, and, although very sick, she was in no way the picture of the open pneumothorax case seen early in the streptococcus infections with such marked dyspnea and respiratory effort as a result of a mobile mediastinum plus

sepsis. She was, however, septic, although apparently draining well for ten days or more and with no signs of involvement of the opposite side.

It seemed wiser to carefully observe this patient, keep up her nutrition, preserve adequate surgical drainage, and then be guided as to future treatment by her response as shown by local and general conditions. This was done for eighteen days, and, as you will see from the chart, her course was not satisfactory; the temperature varying from 99° F. in the morning to 101° and 102° F. in the evening throughout this period, while her pulse averaged about 100 to 110, and respirations 20 to 24; and all this time the discharge noted at her daily dressing was described as "profuse." Her general condition may have improved slightly. Inspection of this chart alone for those eighteen days should make one feel dissatisfied with the course of this case. An uncomplicated empyema when properly drained at operation, and when that drainage is adequately maintained after operation, and particularly with Carrel-Dakin treatment, should run a relatively afebrile course after the first week or ten days, and, if the temperature is persistently up, as in this case, there exists some definite underlying cause, which should be found and eliminated, if possible.

You will note that in this case Carrel-Dakin treatment had not been instituted as yet, and that the patient had been using "blow bottles" daily with apparently no effect. Because of her course, because of the lack of response to treatment, and in the absence of causes other than the local condition, an infected "dead space" with inadequate drainage seemed the most probable etiologic factor for the persistence of temperature in this case, and an exploration was made under gas-oxygen anesthesia.

The drainage tract was found to be definitely contracted and tortuous, with a side pocket leading from the main cavity which only partially drained. These factors were removed by simply enlarging the tract, making it direct, and establishing adequate drainage of the side pocket. It was necessary to resect 2 or 3 cm. more of the eighth rib on each side to accomplish this. All told, this simple operative procedure took fifteen minutes, after

which Dakin tubes were carefully placed *in situ*, and Carrel-Dakin treatment immediately instituted. Her postoperative course is striking. After this simple procedure the temperature rose to 103° F. on the third day, and thereafter came down to normal on the fifth and sixth days, and after one excursion to 101.8° F. on the ninth day came down to normal on the fourteenth day, and remained so until her discharge from the hospital, eight weeks later.

At her visit last week in the Follow-up Clinic, where she was examined, the following note was made: Eleven months post-operative report: Patient has no fever, cough, pain in chest, or dyspnea. Appetite good, strength normal, weight 114 pounds (gain of 22 pounds since operation). Working capacity normal.

Physical Examination.—Patient looks well, good color, eyes clear, well nourished.

Local Examination.—Wound healed, cicatrix freely movable, equal expansion of both sides of chest, percussion note normal on left side, slight dulness from angle of scapula to base on right side posteriorly. Breath sounds normal on left side, somewhat diminished on right side posteriorly from angle of scapula to base.

This is her last *x*-ray plate and, as you see, there is evidence of resection of the eighth rib on the right side in the posterior axillary line, with, however, restitution of the rib. There is no evidence of pneumothorax; there is moderate thickening of the pleura. The pulmonic illumination is otherwise negative. There is no retraction of the heart, and normal diaphragmatic motion was noted on fluoroscopic examination.

This is her condition as you see her today, and so now, almost one year after operation, we will classify her as a good result anatomically, functionally, and economically to date; but we shall, nevertheless, keep her on our active follow-up file for another year.

This case illustrates very well the acute type of empyema adequately drained at the original operation, but which later during the postoperative course developed a very frequently noted and at the same time frequently overlooked condition—inadequate drainage.

This patient at the time of the second operation presented very definitely a "potential" chronic empyema, which undoubtedly would have developed had not adequate drainage been established at that time. Or, in other words, there would have been a gradual transition from an acute type to the chronic type of empyema, which Walton Martin so aptly describes as "having little or no tendency to heal."

The patient I now present, this young man, twenty years old, was brought to the hospital in an ambulance, with the following history: Fourteen days before admission the patient developed cough and pain in the chest, and, although feeling weak and having had chills and fever for twenty-four hours, was still up and about on the streets until he collapsed suddenly, and was carried into a house and later taken home. After remaining in bed for two days he felt better, and so decided to dress and go out again, which he did, but the next day felt "too weak to do anything," and remained in bed. After ten days in bed, upon the advice of friends, a physican was called, who sent him immediately to the hospital in an ambulance. When he arrived here he was acutely ill, with a temperature of 105° F.; pulse rate, 120; respirations, 40; that evening his temperature reached 107° F., and his respirations were extremely labored. He presented signs of a large amount of fluid in his right pleural cavity, with flatness, diminished breath sounds, and voice from the angle of the scapula down, and also fine crepitant râles over the left lower lobe, with fine musical râles over the left upper lobe, anteriorly and posteriorly. The sputum was frothy and mucopurulent.

Aspiration of the right chest revealed thin yellow exudate with a greenish tinge, showing a Gram-positive diplococcus in the smear, and a culture report later of non-hemolytic streptococcus.

Shortly after admission 700 c.c. of exudate were removed from the right pleural cavity by aspiration, and his general condition was somewhat improved. His respiratory effort was distinctly less labored and his increased comfort very noticeable.

Four days after admission his temperature had dropped to 101° F., pulse to 100, respirations to 24, and his general condition

had improved. Within the next eight days his chest was aspirated as the exudate reaccumulated in sufficient amounts to indicate its removal, and he steadily improved, until on the tenth day his temperature was normal. Repeated cultures showed a non-hemolytic streptococcus.

Had this patient been operated upon on admission and an open pneumothorax created the result would, I feel, have been fatal, because, not only was he acutely ill and septic, with marked disturbance of normal metabolism, and therefore unable to withstand any additional shock, but with the pneumonic process still active and therefore with limited pulmonary function and need of oxygen, an open pneumothorax before plastic exudate had partially immobilized the mediastinum, and at least partially walled off the process, would have placed an additional burden on respiratory compensation by its marked change in intrapleural pressure relationships.

The physiologic reasons for this have been ably brought out by Graham and Bell in their original article "Open Pneumothorax, Its Relation to the Treatment of Empyema," which we have gone over together in detail, as well as the later articles by Graham, and I shall not review them further this morning. You will also remember that the clinical results as reported by the Empyema Commission during the war demonstrated the striking drop in mortality in these cases as a result of repeated aspiration, rather than early operation. And so in this case, when finally aspiration revealed frank, yellow pus, when his general condition was very much improved, and the active pneumonitis had cleared up, a rib was resected and drainage established with a local anesthetic, Carrel-Dakin treatment carried out, and after a rather long stay in the hospital he was sent to the country with the sinus closed, and today (almost one year after operation) he is, as you see, quite normal, and his follow-up report shows him to be "capable of his usual work," and physical examination reveals negative local findings except for some dulness beneath the site of scar posteriorly on the right side.

The next case, this boy of seventeen, illustrates a typical

case of the chronic type of suppurative pleurisy. He was admitted to the hospital presenting a discharging sinus of the left chest of eight months' duration. One year before his admission he said he had influenza complicated by pneumonia and pleurisy of the right side, and that his chest had been "tapped three times." He was in bed about seven weeks, and then was able to be up and about, although very weak until a month later, when he was sent to the country, and while there, although at first he seemed to improve, he never fully regained his strength, complained of dull pain in the left chest, and had a slight cough. After having been away almost six weeks he became acutely ill again, with fever, acute pain in the left chest, and prostration. He was brought to the city, where an operation was performed and "over a quart of pus" removed from his chest. Almost immediately he felt better, and in eight days he was discharged with a rubber drainage-tube in the sinus tract.

From this time on for eight months he was treated by several "private physicians," had been in three or four different dispensaries, and finally his mother dressed his wound herself, removing the rubber tube, cleansing it, and then reinserting it each day. Upon examination here he presented a discharging sinus in the left sixth intercostal space, mammary line, and just below this a granulating wound from which thick, yellowish-white pus was escaping. The entire left chest showed practically no expansion. A culture from the purulent exudate showed a Gram-positive diplococcus, Staphylococcus aureus, and non-hemolytic streptococcus. The Roentgen-ray examination revealed an encysted effusion in the left pleural cavity, the upper level being at the second rib, in the midaxillary region, and extending obliquely downward and inward to the cardiac shadow, which with the trachea was displaced to the right. It further showed marked compression of the left lung. The left dome of the diaphragm could not be determined, and the left costophrenic sinus was obliterated. No evidence of tuberculosis was found clinically or microscopically and the Wassermann reaction was negative.

After a preliminary course of Carrel-Dakin treatment a

major thoracotomy was performed, which revealed the following pathology: A cavity with which the two sinuses communicated contained 4 or 5 ounces of thick yellow pus, a relatively small "dead space." Upon further exposure, however, a second cavity was found corresponding to the upper portion of the shadow shown by *x*-ray, which communicated with the first through a narrow tortuous, intrapleural tract. When this was freely exposed about 6 or 7 ounces of additional pus were evacuated. We could now visualize the general cavity, note the markedly collapsed lung, failing to expand because of a thick organized exudate involving the visceral pleura. There was no diaphragmatic action on that side, and the walls of the cavity presented markedly thickened pleura. The entire cavity was irrigated with Dakin solution, after which eleven Carrel tubes were placed *in situ*, extending well up toward the apex.

Because of the gross infection of the dead space at the time of operation it was deemed wiser to attempt to sterilize the cavity before proceeding with the radical removal of the well-organized exudate involving the visceral pleura over the collapsed lung, especially as there was a very real possibility of expansion of the lung and at least partial obliteration of the "dead space," with the use of sodium hypochlorite solution in a cavity which now was adequately drained.

On the day following operation the patient began to use his bottles for deep inspiration, followed by forceful expiration.

Within two weeks the discharge has become distinctly mucoid in character, and its examination revealed an average of 2 to 3 organisms per field. The patient was up and about, had joined the empyema class on the balcony, where our post-operative cases go through regular setting-up exercises under a leader, with emphasis on chest exercises and deep breathing.

One month after operation, although distinctly improved generally and locally, the capacity of the "dead space" having diminished by one-half (by routine determination of the fluid it would contain), the local condition had become stationary, and fluoroscopic examination revealed a very definite limitation of expansion of the left lung.

And so now, in the presence of a relatively sterile field, with the exudate over the lung markedly diminished by the action of the Dakin solution and with a cavity one-half the size of the original, we operated again and decorticated the lung, making crucial incisions where the membrane was so intimately adherent to the lung that we could not peel it off. The wound was completely closed except at the lower anterior portion, where the Carrel tubes were introduced.

He was out of bed on the sixth day, walking about and exercising on the eighth day with the class, and was discharged one month and five days after the second operation, with his wound healed, having gained 16½ pounds since his admission.

Today as you see him, one year later, he has gained altogether 32 pounds, some of which is due to normal growth, and he is very well. This is his *x*-ray plate taken one week ago. There is evidence of the seventh rib resection, with slight retraction of the soft tissues at this point. You will note that the pulmonic fields are normal and one can detect no fibroid changes. The heart occupies a normal position.

This case illustrates what can be accomplished in a persistent type of chronic empyema by, first, adequate drainage and the proper use of Dakin solution, both as a pre- and postoperative measure; second, the results which can be obtained by conservative operative procedures; third, the great importance of postoperative care and the value of regularly performed exercises, especially those involving respiration, and work about the ward, both of which unquestionably improve the local as well as the general condition.

The next case which I shall present is this little girl, who is now seven years old. About eight months ago she was referred to us for treatment through our Social Service Department. Her mother, who brought her to us, had indeed a long story to tell. For four and a half years the child had been an invalid with a discharging sinus of the right chest. When she was a year and a half old she had pneumonia and was acutely ill; three weeks after the onset of this illness the mother was told that the child had "water on the lung" and should be operated upon, and an

ambulance was accordingly summoned and the child removed to a hospital, where an operation was performed and the chest drained. Six weeks later a second operation was performed on the same side, and seven weeks later she was taken home with a sinus of the right chest draining thick white pus.

During the next four and a half years she was treated by several doctors in the community where her parents lived and in many dispensaries, but her condition remained unchanged and the sinus persisted.

Upon her admission here she was a pathetic little figure, emaciated, and undersized. Her thorax was asymmetric, with atrophy of the right pectoral muscles and prominence of the lower sternum. There was slight scoliosis of the spine in the lower thoracic region. Further examination revealed a partially healed scar beneath the right scapula extending forward to the midaxillary region in the sixth intercostal space. At the anterior extremity a sinus persisted about $\frac{1}{2}$ cm in diameter, from which thick green pus escaped. In the right chest breath sounds were harsh just above the scar, with coarse râles; below the scar breath sounds were distant. Percussion of the right side revealed marked dulness over the lower half of the right chest anteriorly and posteriorly. The left chest presented signs of compensatory respiration. The terminal phalanges of all the fingers were clubbed and the nails rounded.

Roentgenologic examination at that time demonstrated, as you will see, from the plate which is now illuminated, fusion of the seventh and eighth ribs, diminution in the illumination in the lower and inner half of the right pulmonic field, the right costophrenic sinus obliterated; the left normal. There is increased density of the shadow of the right hilum and apparently incomplete collapse of the right lower lobe. The left diaphragmatic outline is normal; the right is not visible in the outer half. I call your attention now to this small opaque quadrilateral shadow over the inner portion of the right diaphragmatic dome. It is approximately 1 by 3 cm. in size, with a very definite outline. It suggests very strongly a foreign body of some sort, and we know that the most common foreign bodies found in these cases

are portions of rubber drainage-tubes or pieces of gauze, and that is just what this proved to be at operation, about 2 cm. of ordinary rubber tubing, which seemed to be partially calcified.

Repeated cultures from the sinus showed Staphylococcus aureus, and at no time tubercle bacilli, and sections removed from the tract itself showed chronic inflammatory tissue with no evidence of tuberculosis. The Wassermann reaction was negative, the urine showing a faint trace of albumin, but otherwise negative. The sinus tract admitted a Dakin tube with difficulty for about 15 cm. and was apparently tortuous.

Let us analyze the problem as it presented itself to us. Apparently we had for consideration a partially collapsed lung outside of which was a chronic empyema cavity which was nontubercular, grossly infected with rigid, non-yielding walls. Drainage was obviously inadequate and, in addition, the cavity probably contained a foreign body. Because of these factors it was deemed wiser to carefully explore the cavity, making certain of adequate drainage, and remove the foreign body without the preliminary course of Carrel-Dakin treatment, because of the markedly contracted and tortuous sinus tract which would have made efficient sterilization of the cavity difficult. This was done, and the following pathologic conditions were found to be present: The tract led to a small circular bony orifice at the site of fusion of the seventh and eighth ribs, which was less than $\frac{1}{2}$ cm. in diameter. Upon removal of portions of the fused ribs the dead space could be visualized; it was conical in shape, the floor formed by the diaphragm, the outer wall by thickened parietal pleura, the mesial wall by the thick membrane over the partially collapsed lung, and the roof formed by dense connective-tissue adhesions extending from the collapsed lung to the lateral chest wall. The cavity contained 3 ounces of residual pus and its capacity was estimated at about 10 ounces. There was no expansion of the involved lung and no diaphragmatic action on that side. The foreign body was found and removed and adequate drainage established, the old sinus tracts being completely excised. Carrel-Dakin treatment was instituted.

Following the operation her general condition improved

greatly, but despite the general improvement after two months the local sinus persisted. Repeated fluoroscopic examinations and measurements showed some gain in obliteration of the "dead space" and lung expansion, but adequate sterilization with Dakin solution could not be accomplished despite rigid attention to skin surrounding the wound and careful dressing technic. There apparently existed some reason for the persistent re-infection, and finally we were able to demonstrate infection of the adjacent rib ends with a small sequestrum present.

This was removed and the necrotic rib ends excised. It was with great difficulty that the drainage tract could be maintained owing to the very marked tendency to contract, and it was not until a final operation, fully re-exposing the entire "dead space" and leaving the wound open and freely accessible to the Dakin solution, that we were able to sterilize it. Eight days after the last operation multiple smears from various portions of the cavity showed four organisms in two microscopic fields, and a week later none could be found in 50 fields, and cultures were negative. We were able to maintain this condition until the entire cavity became obliterated and a short sinus alone remained, about 4 by 2 cm. This was injected with bismuth paste, and the wound was completely healed three weeks later and has remained so to date.

Her last Roentgen-ray examination, the plate which you see here, shows the evidence of partial resection of the seventh, eighth, and ninth ribs, a small amount of bismuth in the chest wall in what was previously the sinus tract. There is no evidence of effusion, but throughout the lower right chest is evidence of very definite pleural thickening. Fluoroscopically, the right lung shows good expansion, and this is borne out by physical examination. It is important to keep this patient under observation, as it is too early to be sure of the final result. She is now staying in the country and has gained altogether, since admission nine months ago, about 15 pounds, weighing today 60 pounds.

I have shown this case because it illustrates so well the etiologic factors commonly encountered in these very persistent cases of long duration.

A word or two about postoperative care: We feel that the

postoperative care is of extreme importance in cases of either acute or chronic empyema, and that unless one is constantly on the watch conditions develop which later lead to prolonged chronic infection, and with this in mind we have so organized our after-care that each week, on a chart made for that purpose, we graphically indicate the following things: (1) Food intake in calories, (2) weight, (3) capacity of cavity, (4) bacterial result of smears and cultures, and as soon as a spirometer practical for ward work can be obtained we intend including on the chart the vital capacity, also checked up weekly. In addition to this a résumé of the general condition, temperature, pulse and respiration, and fluoroscopic examination, is made at the same time, and we consider the frequent fluoroscopic examinations of great importance.

In this clinic our operative technic has been simplified in all cases in which a local anesthetic is used by the employment of a syringe with a needle bent in its distal portion at an angle of about 60 degrees for infiltration of the intercostal nerve in the subcostal groove. Such needles as oral surgeons frequently use serve very well.

Our results in chronic empyema have been improved by the following measures:

1. Consistent use of Dakin's solution, with rigid technic as to preoperative as well as postoperative treatment, whenever it can be efficiently carried out in any given case, with emphasis on its postural application.

2. Major thoracotomy so performed, when indicated, as to familiarize the operator by visualization with the actual pathologic conditions which exist. Credit for this type of exposure largely belongs to Lilienthal, in that he early recognized its advantages and widely advocated its use.

3. A graphic chart on which are indicated weekly reports of the important postoperative factors of which I have already spoken.

4. Development of a class for setting-up exercises among the convalescent patients, with also work in the occupational therapy department.

5. Keeping all patients under our immediate care until the sinus is actually closed.

In the surgical treatment of these cases it is of prime importance, as so well expressed by Hedblom in a very comprehensive article on Chronic Empyema reported from the Mayo Clinic recently, to keep before us "the fundamental principles of all good surgery—first the life of the patient; second, the preservation of function as far as possible, and third, the shortening of convalescence."

Finally, the choice of treatment can only intelligently be made by a knowledge of the etiologic factors and pathology in each individual case, and then only can the problem be solved by removing the causes of "the persistent collection of pus in the pleural cavity with little or no tendency to heal."

CLINIC OF DR. CHARLES GORDON HEYD

NEW YORK POST-GRADUATE HOSPITAL

DUODENAL ULCER; PERFORATION; ADHESIONS TO GALL-BLADDER; POSTERIOR GASTRO-ENTEROSTOMY

Duodenal Ulcer: Frequency of Dyspepsia from Reflex Disturbance. Relative Infrequency of Pure Neurosis of the Stomach: Regularity of Symptomatology of Gastroduodenal Ulceration. Specific Characters of Duodenal Ulcer: Hunger Pain, Night Pain. Malignant Degeneration of Gastric Ulcer: Carcinoma of Stomach. Treatment of Ulcer: Technic of Posterior Gastro-enterostomy.

History.—The patient I am presenting this morning is a man forty-two years of age, married, a tailor by occupation. His complaint for the past three years has been pain in the epigastric region. His family history is unimportant and his past history is significant only in the fact that he had typhoid fever twenty years ago. His present illness began three years ago with pain of a cramplike character in the epigastric region. This pain occasionally radiated to the left side of the abdomen and rarely to the shoulder or directly through to the back. The pain came on, as a rule, about two to two and a half hours after meals, and during the first year was always relieved by the ingestion of food. During this period there was never any vomiting nor was any blood observed in the stool. During the second year of the patient's complaint his pain became more intense, was characteristically present two or two and a half hours after meals, and he began to notice that he was awakened at night, usually after 12 o'clock, by the onset of pain. The patient discovered that the pain was relieved by eating and that sodium bicarbonate almost instantly allayed its intensity. Dur-

ing the last year the patient has had attacks of vomiting at irregular intervals and his pain has become more constant, being most intense two or two and a half hours after meals, but lasting almost continuously throughout the day. During the past four weeks the pain has become more severe and at the present time bears no relationship to meals. The pain is neither relieved nor made worse by the ingestion of food. Two weeks ago patient complained of marked gaseous eructations, but without nausea. The patient has never seen any blood in the vomitus or in the stools, nor has he ever been jaundiced. His weight has fluctuated, but without any permanent loss.

Discussion.—In diseases of the right upper quadrant the correct interpretation of a properly taken history is of the utmost importance in arriving at a diagnosis. Moynihan a number of years ago stated that the diagnosis of duodenal ulcer could be made from the history, and all the essential elements necessary for the diagnosis of duodenal ulcer are exhibited in this man's history.

Of 100 persons complaining of gastric distress, or what may collectively be called dyspepsia, in only 20 per cent. will the cause of the symptoms be due to organic disease of the stomach. In 40 per cent. the pathologic lesion will be within the abdomen, but remote from the stomach, and in the remaining 40 per cent. the pathologic lesion will reside entirely outside of the abdomen. In the consideration of dyspepsia one must determine whether the dyspepsia may be classified as a regular indigestion or whether it is of an irregular type. The indigestion that is due to organic disease of the stomach is quite uniformly regular in its chronologic evolution.

In order to diagnose a case of gastric or duodenal ulcer from the history it is necessary that the symptomatology represent three important and cardinal facts: (1) the major complaint of the patient must be pain; (2) there should be a time relationship between pain and food ingestion; (3) periodicity—the recurrence of identical symptoms day after day at approximately the same time.

The dyspepsias due to ulcer have a regular sequence of

symptoms in 88 per cent. of cases. By that we mean that once the symptomatology has been evolved it repeats itself day after day with almost unvarying precision and with characteristically the same grouping of symptoms. This is true whether the ulcer is situated in the stomach proper, at the pyloric ring, or in the duodenum, and it is this essential regularity in the symptomatology of ulcer that makes its diagnosis possible from a carefully recorded history.

In the analysis of this man's history we find that his first complaint was pain. The pain was cramplike in character, was confined to the epigastrium, and had a definite recurrence, in that it came on at more or less definite periods after the ingestion of food. If the patient had been a very careful observer he would have found that the same articles of diet which would produce or be accompanied by pain two hours after its ingestion would always produce the same symptoms day after day in almost unvarying precision. In the first year of this man's complaint we have the three essential elements of ulcer—pain, food sequence, and periodic return. During the second year the symptomatology varied somewhat with periods of remission and with the introduction of the element of vomiting, and in the third year the previous periodicity in the pain gave way to a pain which now became continuous and constant in character.

Assuming the correctness of the diagnosis of ulcer during the first two years of his complaint, there occurred some pathologic process in his ulcer during the last year whereby the periodic element was lost and a constant pain took its place. This constant pain was not influenced either by the ingestion or abstinence from food, and the two factors that most commonly account for this change are perforation or the development of a malignancy. An ulcer complex that loses its periodic character makes one suspicious of the development of cancer or perforation. This man had typhoid fever twenty years ago. This fact is of interest in affections of the right upper quadrant; a typhoid septicemia is one of the important etiologic factors in disease of the gall-bladder. The patient, however, in the intervening twenty years gives none of the signs significant of an infected

gall-bladder, none of the gaseous dyspepsia, the epigastric fulness, the sense of weight or depression, the eructations of gas, or the occasional attacks of vomiting. All these inaugural symptoms of gall-bladder disease are strangely absent.

When an ulcer begins to perforate you have reaction of the adjacent peritoneum with exudation, and you have in greater or lesser degree a localized peritonitis. The moment that this event ensues the pain becomes constant and loses its periodicity by reason of the fact that the exudate that is thrown out to prevent the further progress of the perforation is an inflammatory reaction, and is not affected ordinarily by the ingestion of food. If this man had originally a duodenal ulcer one does not necessarily suspect the onset of malignancy, as the uniform history from every clinic is of the rarity of malignancy ingrafted upon duodenal ulcer. If, however, this history made us suspect gastric ulcer one would be inclined to feel that there was a possibility of malignancy being ingrafted upon a chronic ulcer. This does not seem to be a very pre-eminent suspicion, however, as the man has lost no weight, his digestive functions have remained unimpaired, and, so far as the history is concerned, we are inclined to believe that the man has a chronic duodenal ulcer with perforation and adhesions to the gall-bladder or to the adjacent tissues. We have reached this conclusion entirely from an analysis of the history. It is necessary that we subject this man's complaint to a more thorough test, and pre-eminently in the way of confirmation or denial of our diagnosis will be the utilization of the *x*-ray. Before we ask Dr. Meyer to demonstrate the *x*-ray plates let us consider some of the other data derived from a careful study of this man's condition. Physical examination is practically negative except for a point of tenderness 1 inch to the right and 1 inch above the navel. There is a slight inspiratory spasm upon insinuating the fingers beneath the right costal arch. In every way his physical examination is negative. The pupils react to light and accommodation and the reflexes appear to be normal. I mention this fact particularly, for in a series of tabetics reported by Nuzum and recorded in one of Murphy's Clinics, 97 of the 1000 cases had been operated

upon for supposed abdominal condition, and of the 97 operated upon, 19 were operated upon for gastroduodenal ulcer.

DR. MEYER: "Examination of the *x*-ray plates of this patient shows that peristaltic activity is variable, at times exaggerated, and then at times quiescent. The antrum is distended and at times overactive. Evacuation is irregular and delayed with a medium-sized residue, somewhat crescentic in shape in the midline at the end of six hours. There is evidence of hypersecretion and notwithstanding the delayed gastric evacuation there is a tendency for colonic hypermotility and the duodenum shows a persistent defect. These findings are quite distinctly those of a duodenal ulcer. The pronounced defect along with the shape and size of the residue and, again, because of the lost tone one would surmise that the lesion is an old one, probably calloused, or, on the other hand, there is either a lighting up of an old ulcer or a new ulcer must be suspected on account of the localized tenderness and the evidence of reflex irritability."

The *x*-ray findings are in consonance with our interpretation of the history, and our preoperative diagnosis is that of duodenal ulcer, chronic, probably perforating, with adhesions to the adjacent tissue.

Operation.—The incision is exactly the same as is used for exposure of the gall-bladder. It begins midway between the ensiform cartilage and the costal arch and extends downward and outward and terminates about 1 inch to the right of the navel. By reason of the divarication of the recti muscles above the navel it is unnecessary to divide many of the fibers of the superior rectus muscle. Almost the entire belly of the muscle may be retracted laterally and so allow us to enter the abdomen without interfering with the nerves to the upper rectus muscle.

In performing laparotomy in a clean case one should thoroughly satisfy oneself as to the condition of the entire abdomen. There are ordinarily about six points for exploration: gall-bladder and pyloric zone, the appendix, the sigmoid, palpation of both kidneys, and in women the uterus and adnexa.

We proceed to palpate the sigmoid, the region of the cecum, and usually do a preliminary appendectomy, reserving our main

operative work for the condition which constitutes the indication for the surgery. It is well to remember that in 15 per cent. of all laparotomies there are two conditions either one of which offer a surgical indication for a laparotomy. One has only to recall the more than casual association of gall-bladder disease with the fibromatous uterus and the marked incidence of appendicitis with ulcer, and appendicitis with disease of the biliary system.

The normal postmortem rate for disease of the appendix is approximately about 17 per cent. This is based upon the microscopic examinations and the finding of partially or completely obliterated appendices, and it may be stated that out of 100 persons dead of various causes, 17 per cent. will show the unmistakable evidence of disease in the appendix. In appendices removed during the course of operations for gastric and duodenal ulcer the percentage of diseased appendices rises to 54 and 66 per cent. respectively. This is more than a casual relationship, and lends confirmation to the suspicion that the appendix is a source of focal infection and possibly not an infrequent cause in the production of ulcer of the gastroduodenal segment.

It is claimed that disease of the appendix is one of the most frequent causes of gastric hemorrhage, and one recalls a number of cases of pronounced hematemesis where the complete exploration of the abdomen in the hands of the most expert surgeons has failed to reveal any lesions other than in the appendix. Cases have been reported by Moynihan, Deaver, Mayo, and Moschcowitz of almost fatal hemorrhages as the result of disease of the appendix.

Most of the abdominal viscera are closely related to each other by a neuromuscular mechanism, and one may conceive of the stomach, duodenum, biliary tract, pancreas, and appendix as one essential neuromuscular-physiologic system. In this connection one recalls the close relationship between the ileocecal valve and the pyloric ring as pointed out by Barclay.

In gastric surgery probably the two mechanical factors most conducive to good work are absolute hemostasis and ample exposure. By the introduction of the Balfour retractor and wide

spreading of the wound we have complete visualization of our field. We first recognize the pylorus by means of the superior and inferior pyloric veins, and we have here a very interesting condition—an adhesive process between the gall-bladder and the duodenum. The adhesions are very dense, firm, and suggest the possibility of a cysticoduodenal fistula. Before separating

Fig. 196.—Duodenal ulcer showing plastic exudate, stippling, and adhesions to gall-bladder.

this dense band of adhesions we find here the unmistakable evidences of a perforating ulcer. The nearby duodenum is highly injected, and encircling the base of the adhesion there is marked stippling or little punctate points of ecchymosis (Fig. 196).

There is a plastic exudate on the superior and anterior surfaces of the duodenum which is more or less thickly matted to

the adjacent sides of the gall-bladder. The gall-bladder itself does not show any calculi nor is there any marked thickness of the wall except at the point of contact with the duodenum. There is not sufficient change in the gall-bladder to warrant its removal.

We will now proceed to dissect the duodenum from the gall-bladder so as to allow the gall-bladder to ride free without kinking or fixation. Upon separating the adhesions we find the ulcer is situated on the anterosuperior border of the duodenum about 5 cm. from the pylorus and bringing about a relative duodenal stenosis from invasion and cicatrization.

A purse-string suture of No. 2 chromic catgut will be passed around the ulcer for the purpose of inverting the ulcer and more adequately protecting it from possible subsequent perforation. In addition to this procedure we will anchor a portion of the gastrocolic omentum to this portion of the duodenum so as to completely cover this area with a peritonized surface, namely, that derived from the peritoneum of the omentum.

For the cure of the ulcer we will proceed to do a posterior gastro-enterostomy or, more correctly, gastrojejunostomy. The transverse colon with the great omentum is lifted upward and to the left, thereby exposing the under surface of the mesocolon. I wish to draw your attention to this large blood-vessel which makes an arch on the mesocolon and which represents the colica media artery. Great care should be exercised not to injure this vessel, for if it is injured it must, of necessity, be ligated, and this accident carries with it the possibility of gangrene of the transverse colon in at least one-third of all cases. We now locate the first portion of the small intestine by following down the under surface of the mesocolon until we come to the emergence of the jejunum from under the mesocolon opposite the second lumbar vertebra at the so-called angle of Treitz or the duodeno-jejunal juncture. Occasionally there is a thin film of peritoneum which holds this portion of the jejunum in close apposition to the mesocolon. This is sometimes known as the ligament of Treitz, and if present should be divided in order to make the jejunal loop perfectly free.

The posterior gastro-enterostomy that we are about to perform is sometimes called a no-loop operation. This is not strictly speaking correct, for it is essentially a short loop operation. Some portion of the jejunum must be left free in order to mobilize and approximate it to the stomach. There are in general two types of technic for doing a posterior gastro-enterostomy, depending upon whether one employs the jejunum iso-

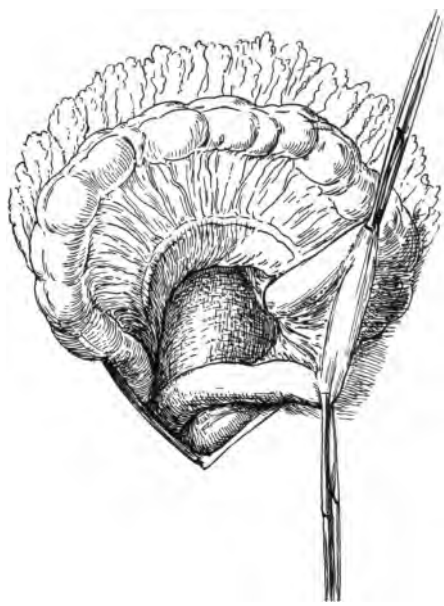

Fig. 197.—Transverse colon lifted up to expose mesocolon with emergence of jejunum at angle of Treitz. Small intestine grasped with two Allis clamps.

peristalticly or antiperistalticly. If the jejunal loop is drawn from left to right (patient's left to right) then the peristalsis of the small intestine is parallel with the peristalsis of the stomach and is known as an isoperistaltic anastomosis. If, however, the jejunal loop is carried from right to left (patient's right to left) then the peristalsis of the jejunum is opposed to that of the stomach and is known as an antiperistaltic anastomosis (Figs. 201, 202). Functionally, it makes very little difference as to

whether the loops are approximated iso- or antiperistalticly. In this clinic it has seemed, as a rule, easier to make the anastomosis isoperistaltic (Fig. 201).

The next step is to place two Allis' clamps on the jejunum approximately 3 inches apart. We do not place these Allis' clamps directly on the antimesenteric border of the jejunum,

Fig. 198.—Proposed line of incision in mesocolon. Posterior wall of stomach pushed down by first and second finger of left hand.

but grasp the bowel about 1 cm. nearer the mesentery on the anterior surface. We do this so that later when we make our incision in the jejunum it will actually correspond to the antimesenteric border of the jejunum. The proximal clamp is placed as near the duodenojejunal angle as will safely allow the bowel to be lifted up and placed in a rubber-covered intestinal clamp and approximated to the stomach (Fig. 197). We now grasp

the transverse colon and omentum between the thumb and first finger of the left hand and pull down toward the lower angle of the wound. This maneuver allows us to place the first and second finger of the left hand on the anterior surface of the stomach, not far removed from the pylorus. We make pressure from above downward on the stomach with our left hand and so force the posterior wall of the stomach into the space beneath

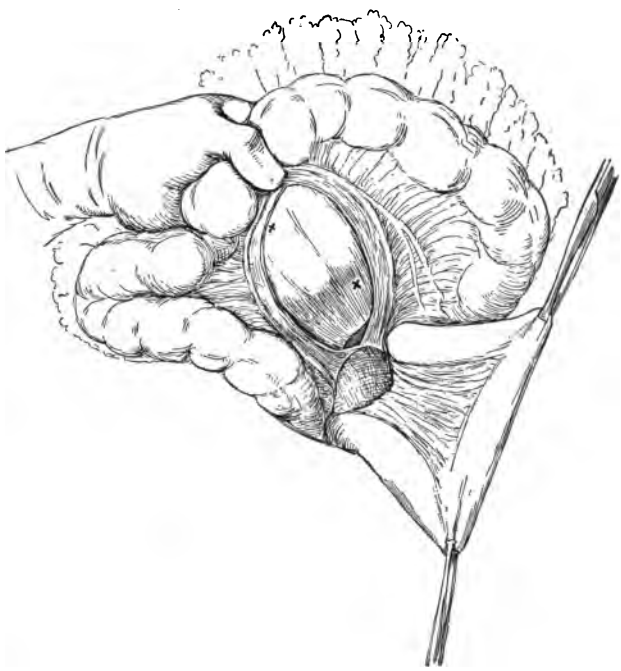

Fig. 199.—Points at which posterior wall of stomach is grasped with Allis' clamps.

the colica media artery. The transverse colon and the colica media artery are lifted up and out of danger by the thumb of the left hand, and we open into the lesser peritoneal cavity by incising the mesocolon below the artery with scissors and blunt dissection (Fig. 198). This aperture is usually made from above downward, and by reason of the pressure exercised by the fingers of the left hand the posterior wall of the stomach readily

protrudes through the orifice into the field. We place one Allis clamp at the greater curvature of stomach as it protrudes, and directly below it, about 3 inches apart, a second Allis clamp is applied (Figs. 199, 200). The direction of these clamps on the posterior wall of the stomach with the patient in the upright position approximates a line drawn from the left shoulder to the

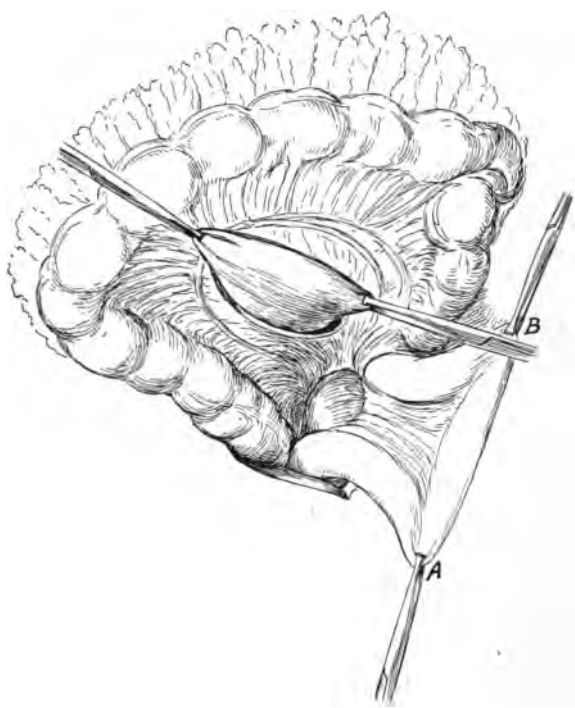

Fig. 200.—Stomach delivered through mesocolon ready for the application of straight rubber-protected intestinal clamps.

right hip, and represents the direction of the anastomosis between jejunum and stomach. We now replace the transverse colon and omentum within the abdomen and apply two rubber-protected straight stomach clamps, one to the loop of jejunum and one to the loop of stomach. It is well to have at least 3 inches of stomach and jejunum in the grasp of the clamps, and you will notice that the two clamps are approximated so that the

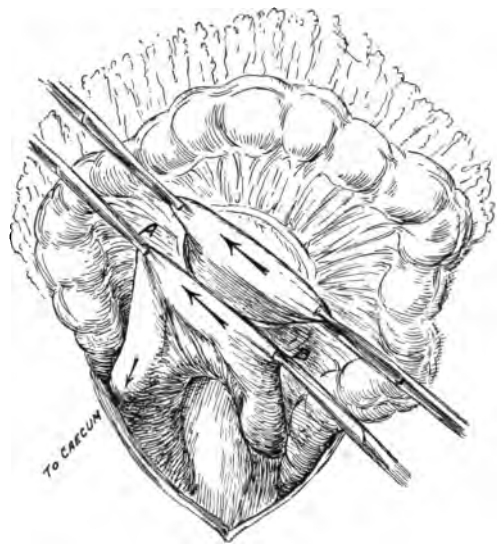

Fig. 201.—The direction of jejunum for isoperistaltic anastomosis

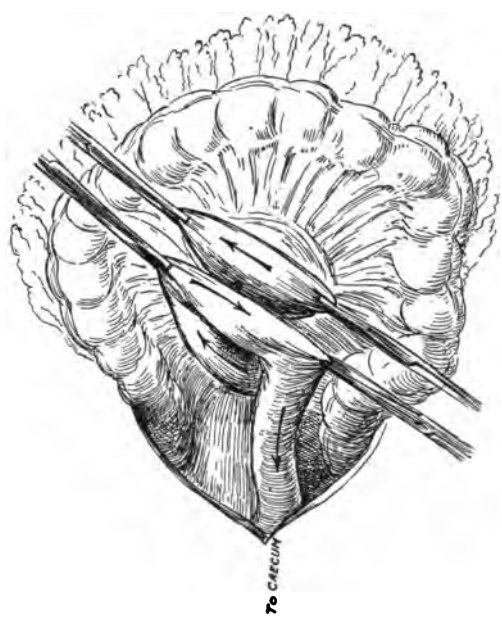

Fig. 202.—The direction of jejunum for antiperistaltic anastomosis.

peristalsis of the jejunum is parallel to the peristalsis of the stomach (Fig. 201). With the superior clamp holding the stomach and the inferior clamp holding the jejunum the entire field is now protected by utilizing five laparotomy pads, one on each side beneath the clamps, one above and below, and the fifth snugly inserted between the stomach and jejunum. We now begin to suture the jejunum to the stomach. With a single Dulox needle swedged on to a No. 1 "tanned extra hard" catgut a continuous Lembert suture is made between stomach and jejunum. This suture line begins at the right-hand side of the patient or nearest to me, and extends at least 3 inches in length, and the last stitch is locked so as to maintain the two loops in

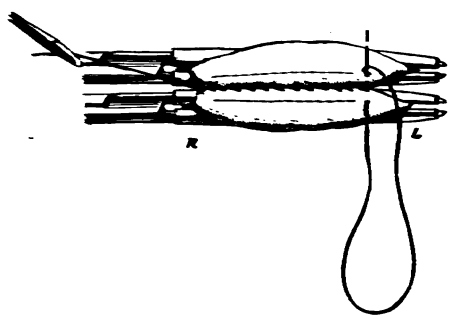

Fig. 203.—The first or peritoneal suture approximating stomach and jejunum. Proposed line of incision for opening loops indicated. (*R.* and *L.* represent patient's right and left side.)

close apposition. This first or peritoneal suture approximates the peritoneum of the stomach to the peritoneum of the jejunum throughout the whole length of the proposed anastomosis (Fig. 203).

The needle and the remaining portion of this suture is wrapped up in a sterile gauze compress and tucked under one of the laparotomy pads, as it will be required shortly to complete the anterior peritoneal approximation. The stomach and jejunum are now opened and each incision begins $\frac{1}{4}$ inch from the suture line and stops short at each end $\frac{1}{2}$ inch from the beginning and termination of the suture line we have just completed (dotted line Fig. 203). The extruding contents of the stomach

and jejunum are carefully mopped up and the field made perfectly dry. We now have two ellipses and four lips, two central—stomach and jejunum—and a superior stomach and an inferior jejunum. We now take a double Dulox needle swedged on to a No. 1 "tanned extra hard" catgut for the inner suture row of the anastomosis. The central lips of stomach and jejunum are lifted up by an Allis clamp at the extreme left (patient's left) of the bowel incision. We begin the inner suture row by tying a knot at the angle nearest to me (patient's right) at about one-third the distance from the first needle of the Dulox double suture. By dividing this suture into three portions

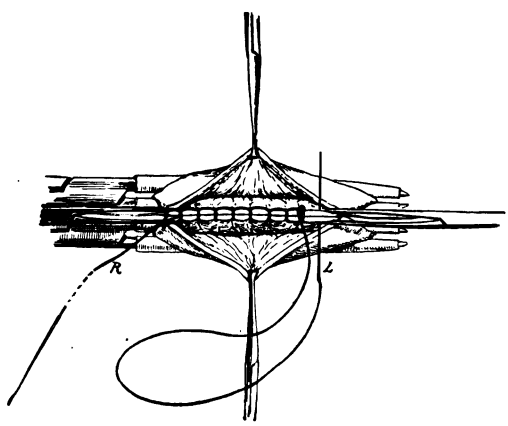

Fig. 204.—The continuous lock stitch for inner row.

we keep one-third wrapped in a sterile compress for later use, while the longer two-thirds is used to entirely encircle the opening between stomach and jejunum and eventually terminate where it began. With the longer two-thirds suture we proceed from the patient's right to left and make a continuous lock-stitch traversing the entire thickness of both jejunum and stomach (Fig. 204). When we approach the opposite end we exercise particular care in placing the so-called angle stitch, for at this point in an anastomosis there is a relative weakness and sometimes a vessel is missed which may give rise to hemorrhage. Notice that the needle is passed from within the stomach to the

outside, then turns and enters the lumen of the jejunum. This procedure makes a very accurate approximation of the angles (Fig. 205). With the same needle we now proceed to bring the mucosa of the upper stomach lip and the mucosa of the lower jejunal lip together. Since both these lips show a protrusion of the mucous membrane this suture approximates only the mucous membrane. This suture proceeds from the patient's left to right as a continuous suture. Approaching the extreme right hand of the anastomosis, this suture is tied with its fellow Dulox and the excess of suture with needle cut off (Fig. 206). Taking up the remaining needle of the double Dulox thread, we proceed

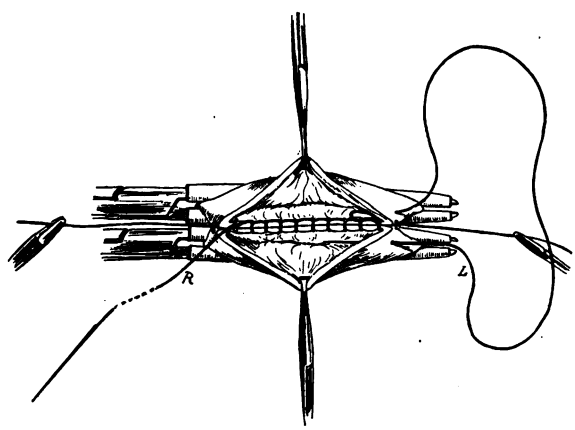

Fig. 205.—The angle stitch at left-hand extremity. (Patient's left.)

from the patient's right to left with a continuous suture which brings together the serosa (Fig. 207), and when this suture reaches the extreme left of the anastomosis it is tied, and we have completed the inner union of jejunum to stomach by one posterior lock stitch and two anterior continuous sutures. The first suture (single Dulox) that was employed is now picked up from under the laparotomy pad, and the peritoneum of jejunum and stomach are approximated by sewing from the patient's left to right by a right-angled Cushing stitch (Fig. 208). The anastomosis is now complete. The holding clamps are removed, the suture line wiped dry, and the transverse colon is lifted up and to

the left. We see again the aperture in the mesocolon through which the stomach protrudes, and we suture the circular edge of the cut mesocolon by three or four linen sutures to the stom-

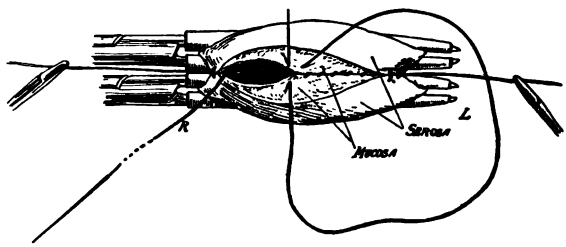

Fig. 206.—Approximation of the mucosa of stomach and jejunum. (First row anterior.)

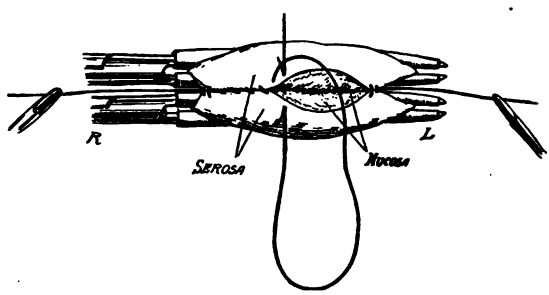

Fig. 207.—Approximation of serosa of stomach and jejunum. (Second row anterior.)

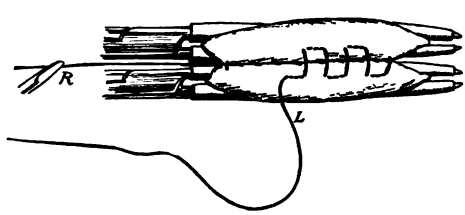

Fig. 208.—The right-angle Cushing stitch for final approximation of serosa. (Third row anterior.)

ach, never to the suture line of the anastomosis of the gastro-jejunostomy. It is necessary to suture the mesocolon to the stomach accurately, but with interrupted sutures so as to prevent any herniation of intestinal viscera into the lesser peri-

toneal cavity Fig. 209. A final inspection of the site of the gastrojejunostomy is made. The transverse colon and omentum are replaced more or less in their natural position and the abdomen closed without drainage.

The cause of death in surgery of the upper abdomen is primarily due to anatomic factors, such as hemorrhage, acute dilatation of the stomach, shock, and seldom does the element of infection become dominant as a cause of death. In operations upon the liver and biliary passages in persons with chronic or habitual jaundice there is in addition to the anatomic factors

Fig. 209.—Suture of cut edge of mesocolon to stomach with three interrupted linen sutures.

that may produce death another element, that of liver exhaustion. In long-continued toxemic processes the reactive hepatic function is lost and patients are unable to react from a moderate degree of operative toxemia. This is particularly apt to occur in operations on the common duct and in conditions associated with chronic pancreatitis. The condition is one of complete vasomotor collapse with wet, leaking skin, tendency to anuria and death, with a clinical picture not unlike shock.

In surgery of the lower abdomen the cause of death is infection and not anatomic conditions. The mortality in gastro-

intestinal surgery can be represented by an ascending line which reaches the maximum point with death from peritonitis in operations on the large bowel and least in operations on the gastroduodenal segment.

In closing the abdominal wound we try to bring about the closure in as nearly an anatomic fashion as is possible: (1) peritoneum; (2) fascia, and (3) skin, supporting the entire wound with figure-of-eight silkworm sutures through skin and fascia. No drainage will be employed.

Postoperative Treatment.—The postoperative treatment of this patient will consist of: (1) nothing by mouth for twelve to twenty-four hours; (2) slight Fowler position or slight elevation of the shoulders by means of two or possibly three pillows; (3) morphin (gr. $\frac{1}{6}$) every four hours for pain or restlessness; (4) routine Murphy proctoclysis consisting of tap-water (not saline) 1000 c.c., glucose 100 grams, sodium bicarbonate 50 grams. This to be repeated once or twice during the twenty-four hours.

At the end of twenty-four hours and in the absence of vomiting 30 c.c. of water will be given every twenty minutes. If this is well tolerated, at the end of thirty-six hours water is usually given with very little restriction as to amount. At the end of forty-eight hours, broths, peptonized milk; at the end of seventy-two hours, broths, milk in unrestricted quantities; and at the end of four or five days, ordinary soft milk preparations (custard, blanc mange, ice-cream); and at the end of a week to ten days, limited regular hospital diet.

In the absence of temperature, increased pulse-rate, or local pain the wound will not be dressed for seven days, when a clean dry dressing will be applied. The silkworm sutures are removed on the twelfth day and the patient allowed up some time about the twelfth or fourteenth day.

After-result.—Patient made an uneventful recovery and left the hospital on the twenty-third day after operation. Wound in excellent condition.

CHRONIC APPENDICITIS; PYLORIC SYNDROME; APPENDECTOMY

Pyloric Syndrome: a Reflex Manifestation of Disease of the Appendix. Indefiniteness of Appendical Dyspepsia. Pain Over McBurney's Point Seldom Indicative of Chronic Appendicitis. Gastric Reflex Disturbances More Readily Induced by Chronic Infection of Appendix than Local Pain. Appendectomy Technic. After-treatment.

History.—The patient I am presenting is a woman thirty years of age, married, residing in the United States for the past ten years. She enters the New York Post-Graduate Hospital complaining of "sick stomach," nausea, and vomiting, periodically for the past two years. She has had in all six attacks, and each succeeding attack is more severe than the previous one. Her past history is negative. Menses began at sixteen, regular, duration three to four days, with an after-day of "spotting," moderate amount, and occasionally has pain, but rarely goes to bed during the period. The patient has had one child born with forceps and with laceration of the cervix and vagina, with an immediate perineorrhaphy.

Her present trouble began two years ago, and since then has manifested itself by six attacks of "indigestion." The patient feels comparatively well until the attack, when she would be seized with cramplike pain in the epigastrium with nausea. The attack usually lasted from three to ten hours, and the last attack was the most severe of all. These attacks came on first with a feeling of nausea and are followed by regurgitation of "sour water" into the mouth. Within an hour pain occurs which begins in the epigastrium, spreads over to the right side, radiates to the back. It is of a knifelike character and intermittent rather than continuous. The pain has been so severe that she has had to go to bed during the last three attacks, and necessitated the calling of a doctor in order to obtain relief. The pain remains

from three to ten hours, then subsides, and the patient feels comparatively well until the next attack.

The attacks have usually occurred either at 6 P. M. or after midnight, although two of the attacks have occurred in the daytime. The patient is able to eat food, but has no great desire for it during the attack, and such food as she has eaten has never borne any relationship to the character, intensity, or localization of the pain. The patient has never been jaundiced; has never observed any blood in her stool, nor has she taken soda bicarbonate for the pain or reguritation. The most recent attack began about a week ago and subsided within twenty-four hours.

The physical examination at the present time is comparatively negative except for some general abdominal sensibility. In the seven days that the patient has been under observation she has been afebrile, with a pulse-rate between 70 and 80, and resting in bed in comparative health. Wassermann is negative and pupils react to light and accommodation. The reflexes are normal.

Radiographic examination of the gastro-intestinal tract shows a medium-sized stomach of the orthotonic type. The pylorus is of the spastic type, seen high, and to the right at the level of the third lumbar vertebra. There is no true intrinsic gastric defect, though a shelving appears in the pars cardia, apparently due to gas distention of the splenic flexure. The bulbus is small and when filled is triangular in shape and smooth in contour. Peristalsis is visualized over both curvatures. The antrum is not distended. Evacuation is rapid. There is no residue at the end of six hours. The motor meal shows fairly normal distribution in the ileum and cecum. Examination at the end of twenty-four hours shows the cecum slightly distended. It is freely movable and not noticeably tender to pressure. The appendix is not visualized.

Diagnosis: Chronic appendicitis.

Discussion.—We have here a patient thirty years of age, rather thin and of rather marked nervous temperament, who has had six attacks of pain in the epigastric region in the past two years. This pain is preceded by a sensation of nausea and the regurgitation of bitter, sour material. The attacks have come on

spontaneously without warning, have been of maximum severity after they began, have had a duration of ten to twelve hours, and have been equally distributed in their time of onset during the day and night. The history is strikingly clear as to the absence of any disturbance between the attacks. One must assume, therefore, that these attacks are ushered in by a neuromuscular mechanism which disturbs the normal motor and secretory functions of the stomach as evidenced by the regurgitation of bitter, sour material. The pain is localized to the epigastrium and is of intermittent, colicky, cramplike character, and one must assume that whatever the cause or in whatever region of the abdomen this cause is operating the mechanical factor is that of hyperperistalsis or spasm. We can assume, therefore, that the pathology which induces this syndrome resides within the abdomen. It is necessary to clearly establish that this is an intra-abdominal irritation, for 40 per cent. of the indigestions are due to causes extrinsic to the stomach but within the abdomen, and 40 per cent. are due to causes entirely remote from the abdomen. Numerically the most frequent cause of indigestion is: first, heart disease; second, phthisis; third, anemia and chlorosis; fourth, neuroses or psychoneurosis; and fifth, chronic nephritis. These conditions are all remote from the abdomen and can be eliminated in this case.

If we are justified in assuming that the cause of this woman's trouble is within the abdomen, we must differentiate, roughly speaking, between intrinsic affections of the stomach and duodenum, the gall-bladder, the appendix, the pelvis, and the large and small intestines. Let us consider in detail gastroduodenal ulceration. The history of gastroduodenal ulceration is not the history as given by this patient. The evolution of an ulcer and its inherent symptomatology is such that the symptoms produced are present over a longer period than ten hours and the interval of relief is not calculated in months, but hours. This woman has an attack of pain, nausea, and regurgitation of ten hours' duration, and then is completely well for six months. This certainly is in no way similar to the regular dyspepsia of ulceration. Again, the history presented by this woman does not correspond to the

history given in cholecystitis or cholelithiasis. Outside of the ten hours of her attack her gastric function is excellent. This is not the story in cholecystitis, where for a long period of time as the result of infective processes in the gall-bladder there is produced more or less continuous, although occasionally interrupted, gastric distress. Affections of the large or small intestine are certainly eliminated by the *x*-ray examination, and there is nothing to be determined by bimanual examination of the pelvis to suggest a reflex disturbance from the uterus or adnexa, so that by a process of elimination we must believe that the pathology producing the symptoms in this patient is that of a chronically infected appendix.

We are not overlooking the possibility of ureteral stone, as this has been eliminated by our *x*-ray examination.

If there is anything in the symptomatology of a chronically diseased appendix it is found in the extreme variability of the dyspepsia and the lack of regularity in the evolution of symptoms. Articles of food that at one time are associated with indigestion may be eaten with zest and relish on other occasions. The mechanism in the production of the symptomatology in the large majority of cases is probably that of pylorospasm, with pain, increased secretion, increased acidity, gaseous and sour eructations, and occasionally vomiting. This variability, in so far as its diagnostic possibilities are concerned, may be found epitomized by the statement of Moynihan that the most frequent site of ulcer of the stomach is in the right lower quadrant.

The ordinary postmortem incidence of disease of the appendix is approximately 17 per cent. It is interesting to note that the appendix shows pathologic changes in 69 per cent. of the cases of cholecystectomy, whereas 55 per cent. show disease of the appendix in cholecystostomy. It must not be forgotten that chronic disease of the appendix may occasion a rather severe hematemesis. Gastric ulcer is associated with disease of the appendix in 54 per cent. of cases, while duodenal ulcer is associated with disease of the appendix in 66 per cent. of cases, and in 15 per cent. of all laparotomies there are two lesions sufficiently severe to warrant operation.

Hutchinson records 24 cases of fatal hemorrhage from the stomach after operations of various kinds upon the abdominal viscera. Of these 24, 21 were cases of appendicitis with septic complications. I have records of 4 cases of pronounced gastric hemorrhage which on very extensive abdominal exploration revealed no morbid process except in the appendix, and following an appendectomy there was a cessation of gastric distress and gastric hemorrhage. Gastric hemorrhage has been experimentally produced by Rogers by injecting chemical irritants into the cecum and ascending colon, while irritation of the colon, *per se*, has been shown to bring about a gastric stasis and the delayed passage of food material through the small intestine.

Barclay quite recently has drawn attention to the spasmodic closure of the pylorus following reflex stimulation from the terminal ileum, when there is too rapid overloading of the small intestine with chyme. Biologically the ileocecal valve represents a great point of chemical and bacterial partition, for at the cecum we have a change in chemical reaction: maximum bacterial flora, maximum fluidity, anastalsis, predominant lymph tissue, and a point of natural or normal stasis. These observations would seem to offer proof of a very extensive system of intra-alimentary reflexes acting upon the pyloric mechanism, and it would serve to explain the incidence of appendicular dyspepsia.

"Appendix dyspepsia" is a varied and indistinct clinical picture. It is usually more difficult to diagnose than either the conditions of ulcer or disease of the gall-bladder. If one can eliminate either of the two conditions named above it should be possible to arrive at a diagnosis of appendicular dyspepsia by elimination. In the ordinary case there is usually an absence of a history of an acute attack. Epigastric distress is a source of intermittent annoyance or sense of ache, and usually with no distinct relationship to food. The pain or distress is apt to be aggravated by activity and motion and is occasionally relieved by an enema or a cathartic. It is infrequent for appendicular dyspepsia to be associated with a history of acute attacks, although occasionally local appendical pain may be elicited.

It is noteworthy that the pain and distress is usually more prolonged than similar occurrences in disease of the gall-bladder. The distress is usually located low down in the epigastrium or at about the navel, and lacks the distinct characters of localization as in biliary disease.

Another interesting factor in this patient's history is that the attacks have been becoming more severe, each succeeding attack being more intense than the preceding ones and with a tendency toward shortening of the interval between attacks. I think that this can be explained by the relatively increasing stenosis of the appendical lumen. With each attack there ensues a slight increase in the degree of infection resident in the appendix, and with the tumefaction and edema and temporary occlusion of the appendix there is produced retention of infected feculent matter. In the spasm of the walls of the appendix in its effort to rid itself of the retained contents a pronounced irritation is given to the entire small intestine, to the ileocecal valve and to the pylorus, and the hyperactivity of the small intestine demonstrates the physiologic law that wherever in the gut tube there exists a point of irritation there is an increase in the normal functions of the gut segment above the point of irritation, and we have hypermotility and hyperperistalsis of the small intestine. The reflex pylorospasm may account for the increase in secretion and the disturbed motor function of the stomach. After the appendix has been able to free itself of its retained contents resolution takes place, leaving behind an appendix slightly more susceptible to another attack, and the cicatrices which exist in the form of strictures within the lumen of the appendix make for increased severity with each succeeding attack. Accordingly, from all angles it seems that the clinical picture herein presented is best explained upon the assumption of a diseased appendix.

It is interesting to note that the cases that we have operated upon for chronically diseased appendices and whose only complaint was pain in the right lower quadrant have, as a rule, not been uniformly benefited by the operation. Where we have corrected a dilated or atonic cecum or done a cecoplication and, more rarely, cecofixation, or have attended to a gross pathologic

change in the cecal region or in the tube and ovary, these cases have been cured of the pain in the right lower quadrant, but where a simple appendectomy has been done for the sole complaint of pain in the right lower quadrant we have been chagrined to find that these patients have not been cured by an appendectomy. Accordingly, a symptomatology embracing only pain in the right lower quadrant without any other confirmatory sign is usually not the type of abdomen that is going to be cured of its pain by an appendectomy. On the other hand, cases that have had a subacute attack of appendicitis with so-called appendicular colic of epigastric pain, nausea, eructations or vomiting, and then a subsidence of the symptomatology, have been uniformly cured by the removal of the appendix.

Operation: Incision.—It is essential in this patient not to overlook any pathologic process in the gastroduodenal zone, in the gall-bladder, kidneys, sigmoid, or pelvis.

Accordingly, we will make our incision somewhat higher on the abdominal wall than one would ordinarily make for a simple appendectomy. We seldom use the McBurney intermuscular incision on account of the inability to properly explore the abdomen, and this patient certainly has the right to a thorough exploration of her abdominal contents which can only be carried out by a properly placed incision.

Our incision will begin 2 inches above the level of the navel and 1 inch from the median line, and continue down a distance of 2 inches below the level of the navel. The anterior sheath of the rectus will be divided and the fibers of the rectus muscle split in the direction of the incision. This incision allows us to extend it either upward or downward, depending upon any secondary pathologic process that may be discovered. We first ascertain the condition of the pylorus, and we find there is a normal pyloric ring, no ulceration of the duodenum or in the stomach; the gall-bladder is normal in color, its walls are thin, there is no deposition of saffron-colored fat, and by introducing two fingers into the foramen of Winslow we ascertain that the common duct is normal, that there are no enlarged glands about the cystic or common duct, and that we have a negative biliary

system. The spleen is normal in size and the left kidney is normal in size, shape, and mobility. The uterus has a very small fibroid on the anterior surface about the size of a hazelnut and both tubes and ovaries are normal. By carrying out a systematic exploration in this manner we have left the region of the cecum and the appendix for our operative procedures. The cecum and appendix are delivered out of the abdomen, and we find that the appendix is kinked at its midportion, that it has a bulbous extremity with three very distinct points of constriction. It is

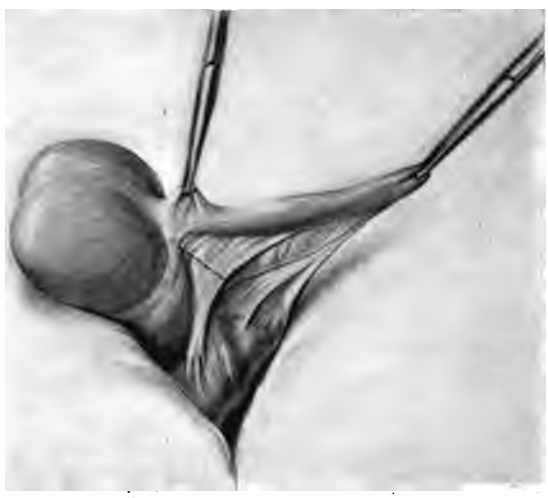

Fig. 210.—Appendix delivered and made taut by grasping with Allis' clamp. Division of adventitious bands as indicated. Note ureter passing over iliac vessels.

held down to the external lateral peritoneal wall by an adventitious adhesion and we will divide this. By cutting this adhesion with a scissors the appendix rides free and can be delivered easily out of the wound (Fig. 210). By making gentle traction upon the end of the appendix with an Allis clamp the meso-appendix is straightened out and the blood-vessels are easily discerned. Note beneath the border of the meso-appendix the ureter passing down over the iliac vessels to enter the pelvis. The proximity of the appendix to the ureter explains many cases

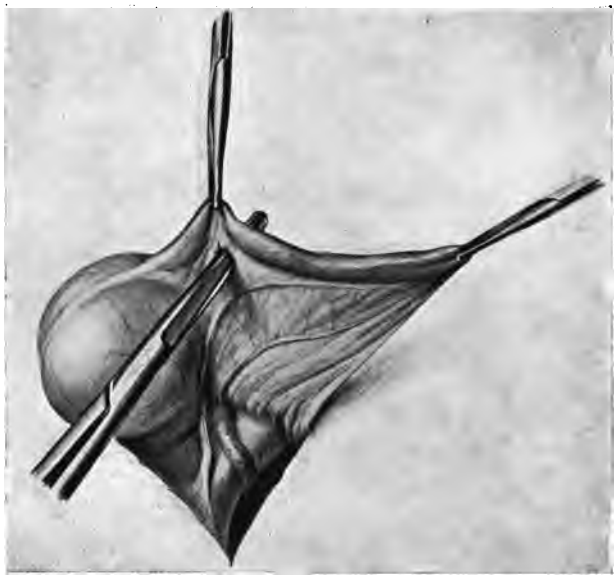

Fig. 211.—Perforation of meso-appendix preparatory to clamping.

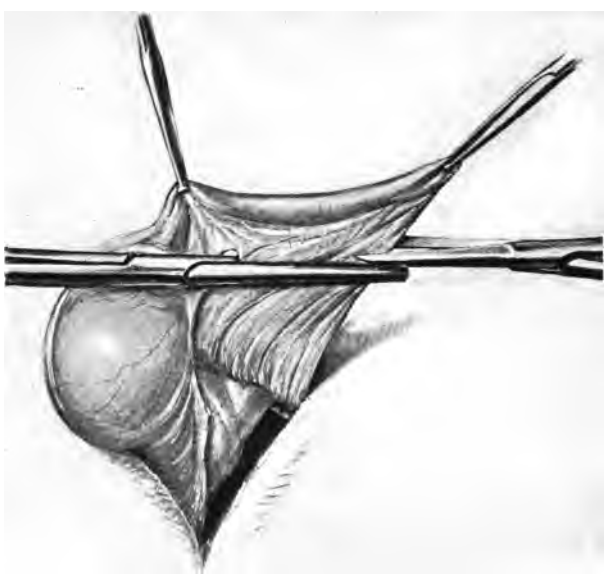

Fig. 212.—Clamping of the meso-appendix and dividing so as to free the appendix. If the meso-appendix is long and wide it may be necessary to employ two or three artery clamps.

of irregular attacks of supposed renal colic with a showing of blood and pus in the urine. The reverse of this condition is very interesting where a small stone impacted at the brim of the pelvis may simulate a chronic appendicitis. The meso-appendix is transfixed close to the cecum (Fig. 211) and a clamp applied to the meso-appendix (Fig. 212). If the appendix is long or there

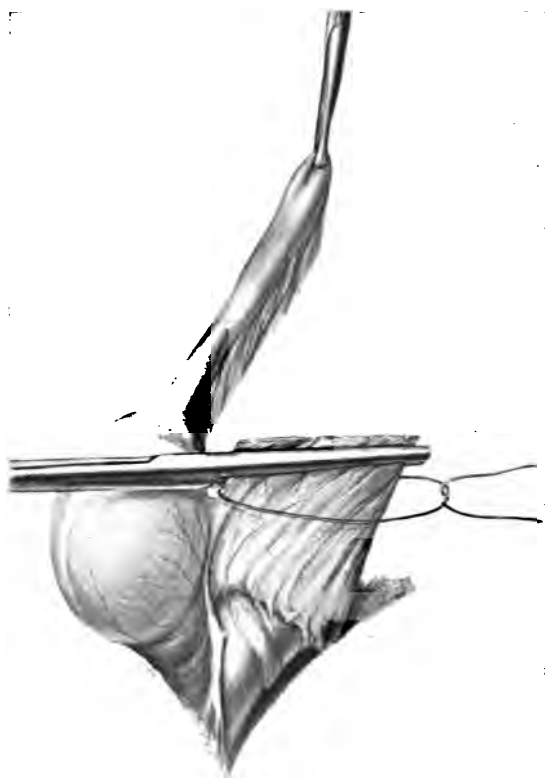

Fig. 213.—Ligation of the meso-appendix with No. 2 plain catgut.

is an unusual width to the meso-appendix it may be necessary to use two or three clamps after this manner in order to properly divide the meso-appendix for ligation. We will tie the meso-appendix with No. 2 plain catgut (Fig. 213) and will now crush the appendix close to the cecum (Fig. 214). The purpose of crushing the appendix is to destroy the mucous membrane and

thereby bring about the obliteration of the lumen of the inverted stump of the appendix much more readily.

We ligate the appendix in the crushed area with No. 2 chromic catgut. The next step in our operation is to pass a purse-string with Pagenstecher thread so as to make a loop en-

Fig. 214.—The appendix crushed with artery clamp—close to cecum and in crushed area ligated with No. 2 chromic catgut.

closing the stump of the appendix and with a diameter of about $1\frac{1}{2}$ inches. This purse-string begins at the side opposite to us and each succeeding stitch transfixes the head of the cecum at regular intervals. If one considers the head of the cecum as representing the dial of a watch, with 12 o'clock directly oppo-

site, our purse-string suture is placed by beginning at 12 o'clock, transfixing at 10, 8, and 6. A small loop is left at 6 o'clock and the purse-string continued by transfixing at 4, 2, and back to 12 (Fig. 215). We have now placed the purse-string and will proceed to amputate the appendix. A small piece of gauze is placed beneath the appendix and the appendix is clamped about

Fig. 215.—General appearance of the purse-string showing two divergent points of traction. Appendix tied and ready for amputation.

1 cm. distant from the ligature occluding the appendix. The clamp is placed on the appendix to prevent back-flowing of contents, and with a knife the appendix is divided between the ligature and the clamp (Fig. 216), and the clamp, gauze, and appendix are removed *in toto*, leaving the stump of the appendix standing erect by reason of the traction made with the purse-string. The stump of the appendix is touched with pure phenol,

but is not neutralized with alcohol, and with a plain thumb forceps the stump of the appendix is inverted into the head of the cecum. At the moment that that stump of the appendix is inverted below the level of the purse-string the loop is slipped off the little finger and a quick jerk of the two threads between the thumb and first finger completely occludes the aperture and permanently inverts the stump of the appendix (Fig. 217). We

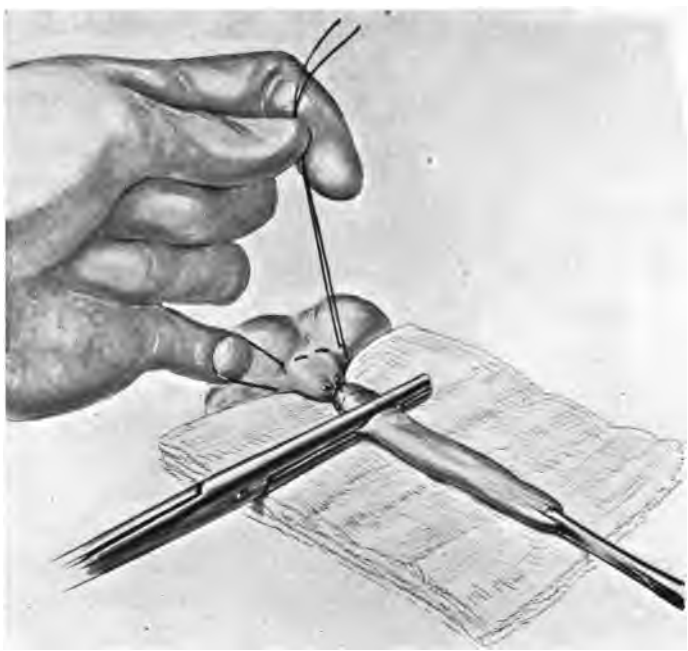

Fig. 216.—Amputation of the appendix between ligature and clamp. The appendix, clamp, and gauze removed all in one piece.

have used this technic almost uniformly in this clinic for the past eight years and have been well pleased with it. Its distinct advantages are that there is no soiling of the operator's fingers nor of the nearby tissue, and the inversion of the stump of the appendix is complete and easily accomplished on account of the cecum being held at two divergent points, the one by the loop over the little finger and the other by the two threads between the thumb and the first finger.

Postoperative treatment of this patient for the first twelve hours will be: (1) nothing by mouth, (2) slight Fowler position, (3) Murphy proctoclysis, and (4) morphin sufficient to keep the patient quiet and free from restlessness.

After-result.—The patient was dressed on the fifth and tenth days after operation. She made an uneventful convalescence

Fig. 217.—Inversion of the stump of the appendix. While holding loop of purse-string over little finger and the two free ends between thumb and first finger the appendical stump is inverted, and at the same time the loop is slipped off little finger and the two free ends pulled taut and tied.

and was discharged from the hospital on the tenth day after operation. The wound was in excellent condition.

It is rather early to determine the eventual cure of this patient, but up to the present time (April 1, 1921) the patient states that she has enjoyed better health than at any time in the last ten years.

CHOLELITHIASIS; CHOLECYSTECTOMY; APPENDECTOMY

Cholecystitis, Cholelithiasis, Diagnosis of Biliary Disease. Differential Diagnosis from Gastroduodenal Ulceration and Diseased Appendix. Discussion as to the Merits of Cholecystectomy and Cholecystostomy. After-results in Biliary Disease. Technic of Cholecystectomy.

History.—The patient I am presenting this morning is a woman twenty-six years of age, married, born in Russia, but resided the last six years in the United States. She entered the New York Post-Graduate Hospital complaining of "pain in the upper abdomen," right side, for the past two years and markedly worse during the past two months. The family history is unimportant. The patient has never had typhoid fever or any septicemic process of pronounced type. She has had two children, one two and a half years of age and the other seven months. The patient's menstrual and obstetric history is negative.

In narrating the story of the present illness the patient states that she has had more or less continuous "stomach trouble" for the past two years. This affection has been variously ascribed to "nervous stomach" and "gastritis." During the period of this so-called stomach trouble the patient states that there have been intermittent attacks of gas which would form in the upper part of the abdomen, followed by belching and occasionally by vomiting. For the past two months this gaseous dyspepsia has given place to intermittent attacks of pain, of cramplike character, coming on at irregular periods, mostly at night, and on two occasions the pain was so severe as to require hypodermic injections of morphin. For the last ten days the pain has been more or less continuously present and is described as a dull aching pain confined mostly to the right upper quadrant. There is no history of jaundice. The patient has been under observa-

tion for the last week, during which time she has had a normal temperature, pulse, and respiration rate. A physical examination of the abdomen reveals a markedly thick abdominal wall with tenderness in the right upper quadrant. There is a marked inspiratory spasm upon deep infracostal pressure when the patient takes a full inspiration (Murphy sign). There is no tenderness over the region of the appendix and the pelvis is negative upon bimanual examination. The pupils react to light and accommodation and the reflexes are normal.

No *x*-ray examination has been made of this patient because we are reasonably sure of our diagnosis. We believe this woman has a chronic cholecystitis with gall-stones.

Discussion.—A critical analysis of this woman's history reveals that her trouble has its symptomatic evolution in two phases. The first is represented by a period of gaseous indigestion and the second by the acute onset of attacks of pain. From the chronologic order of her symptoms no less than the specific character of her complaint one is justified in making the diagnosis of cholecystitis.

If we conceive the stomach as exercising in the main two functions—that of motor function and secretion—we may reasonably expect that any irritative condition that reflexly affects the stomach would probably cause an aberration in one or both of these two functions. For a long time medical opinion considered gall-stones the only pathologic evidence of diseased gall-bladder, and gall-stones were interpreted as the essential pathologic process. With refinement of diagnosis, the extraordinary development of the *x*-ray, and other laboratory procedures there has ensued a reconstruction of our pathologic conceptions of the affections of the biliary tract. From the pathologic study that has emanated from the operating room it has become definitely established that it is the infection of the biliary tract itself which gives the surgical indication rather than the accidental sequelæ or incidental occurrence of stones.

In the strawberry gall-bladder of Moynihan stones are absent, likewise in some forms of fibrosis of the gall-bladder there is an absence of stones. It is the infection that begins in the

gall-bladder which sets in motion a series of changes bringing about the inaugural signs of cholecystitis—the symptoms of gaseous indigestion. This indigestion is due to motor and secretory disturbances in the stomach, reflexly produced by infective changes in the gall-bladder. In speaking of gastroduodenal ulceration we refer to the regularity of the symptomatology, while in speaking of cholelithiasis we speak of the irregularity of the dyspepsia that is produced. In gall-bladder disease the indigestion is vague, irregular, with an ill-assorted grouping of symptoms. This indigestion conforms to no rule and exhibits no constancy. It is characterized by an absence of periodicity, and it may be catalogued by its most predominant symptom, gas production—flatulency. In gall-bladder disease there are various degrees of gas production. There are eructations, sense of fulness, weight or oppression, occasionally with tenderness along the right costal margin. There may be a catch in the right side upon taking a full breath, and occasionally after large meals a slight sensation of chilliness or goose-skin sensation. This gaseous indigestion is characteristically made worse by the eating of any fried foods or greases, or less commonly apples, nuts, and cheese. There usually is some relief upon the raising or belching of gas and almost complete cessation of the symptoms upon vomiting. Occasionally the history is obtained of the patient retiring after dinner, and voluntarily inducing vomiting with almost complete amelioration of the symptoms. It is worthy of note that the patient is relatively free from symptoms when the stomach is empty, in marked contradistinction to duodenal ulcer, where the patient is usually at his best when food material is in the stomach. This form of indigestion may continue for an indefinite period of time and exhibit itself without any marked variation in the above picture. After a long or short period of the above qualitative dyspepsia there is introduced into the patient's history another symptom, different from any of the preceding symptoms, and this is represented by a sudden, acute attack of agonizing pain. The onset of the second phase of symptoms is quite characteristic. Out of a clear sky, without any warning or premonition, the patient is seized, usually

in the evening, with a sudden, intense, severe attack of cramp-like pain, usually in the right upper quadrant. This pain comes on like a stroke of lightning, radiates through to the back, occasionally down the right side or up over the right chest, and less frequently toward the left breast. It is of maximum intensity, is associated with restlessness upon the part of the patient, and usually so severe as to require the presence of a doctor and the hypodermic injection of morphin. This agonizing pain lasts a variable length of time, four to six hours, disappears almost as quickly as it came, leaving a residual soreness in the right upper quadrant or along the right costal margin. There may or may not be, in addition, some temperature during the height of the paroxysm.

The patient this morning exhibits these two phases in a somewhat variant degree, but certainly two facts are positive: (1) the history of gastric distress of rather mild type for two years and (2) this dyspepsia has been succeeded by a series of attacks of intense upper abdominal pain. If we add to this historic data the positive Murphy inspiratory spasm, both in the recumbent position and in the sitting position, we feel sure the patient has a chronic cholecystitis. During the reading of this history there occurred the positive statement that there had never been any jaundice. Jaundice is not a symptom of simple cholecystitis, but is usually a symptom of cholangitis or calculous obstruction within the lumen of the common duct or occasionally of infection of the cystic duct with edema and pressure upon the common duct.

In considering jaundice in biliary disease statistical inquiry has demonstrated that according to its causation jaundice may be classified in the following numeric order: (1) gall-stones, (2) catarrhal jaundice, (3) cancer of the liver, (4) cirrhosis, (5) cancer of the bile-ducts and gall-bladder, (6) cancer of the pancreas, and (7) gastric and duodenal carcinoma (Fig. 218). It will readily be seen that by eliminating catarrhal jaundice and cirrhosis of the liver the diagnosis becomes one of differentiating between the jaundice due to gall-stone disease and that from malignancy of the bile-ducts.

Catarrhal jaundice is an example of a disease named after its most prominent symptom. Its designation is without any adequate or stable pathologic basis. The diagnosis of catarrhal jaundice is one of the most insecurely founded of all diagnoses at the present time.

Jaundice that comes on with or without gastro-intestinal disturbances, that has a duration of four to six weeks, and then

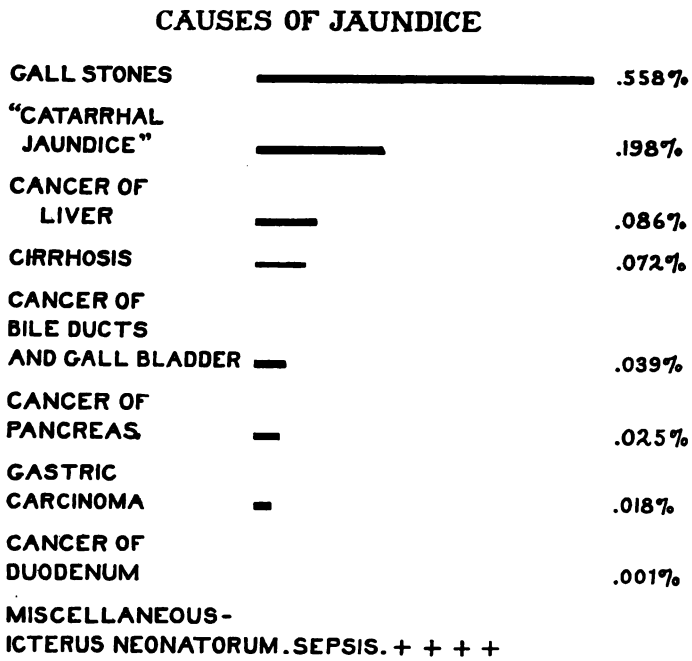

Fig. 218.—Statistical tabulation showing the causative factor in the production of jaundice.

spontaneously clears up, must, however, with our present knowledge be designated catarrhal jaundice. The outstanding clinical feature is the slight systemic changes in the presence of jaundice. Herein it differs from all other types of jaundice where the systemic changes are marked. Emaciation during an attack of jaundice has little clinical value, as emaciation occurs equally with gall-stones, catarrhal jaundice, or malignancy. Finally,

only a "cure" within six to seven weeks can be considered as establishing the diagnosis of catarrhal jaundice.

A case of jaundice that does not clear up within six weeks is either a complication of another condition or the diagnosis is wrong. The deep green or black color of pure obstructive jaundice is never seen in catarrhal jaundice, although the effects of long-continued icterus may be evident. Stupor never occurs in the mild types of jaundice, and is absent in gall-stones and even in malignant disease except at the terminal stages. Only in two forms of liver disease is stupor a factor in the presence of jaundice, namely, cirrhosis and acute yellow atrophy.

Jaundice due to gall-bladder disease rarely develops after the first attack, and still more rarely does it appear suddenly and without colic; 99 per cent. of gall-stones are formed in the gall-bladder, and to reach the more ample common duct must migrate through the cystic duct. In the course of this migration colic is developed, and only when the calculus reaches the distal portion of the cystic duct may jaundice arise either from compression or coincidental inflammation (Fig. 219).

If one were to take the life-history of a large number of cases of disease of the biliary apparatus he would find that they presented a composite picture in which four well-defined stages of pathology were evidenced: (1) When the disease was confined to the gall-bladder; (2) when there are attacks of biliary colic; (3) when jaundice occurs from common duct obstruction, and (4) when infection or calculi produced coincident disease of the pancreas.

In our patient the history clearly exhibited the first two stages. One could predicate the subsequent development of common duct disease were the patient to continue without surgical intervention. After a variable period the third phase of biliary disease may be introduced by an attack of pain similar to the one outlined, to be followed in four to six hours with jaundice which reaches a maximum intensity within twenty-four to forty-eight hours, and associated with the evidence of a well-defined sepsis—chill, fever, and sweat, suggesting in its onset and periodicity a malarial paroxysm. Years ago this was known

as intermittent hepatic fever (Charcot) and variously ascribed to malaria.

The diagnosis of calculous disease of the common duct rests upon colic, icterus, and sepsis, and the symptoms occur in that order. In cystic duct obstruction there is colic and fever, and the symptoms occur in that order, but there is no jaundice. In calculous disease of the common duct one is impressed by the fact that at the time the patient presents himself jaundice is absent in about 25 per cent. of cases. Inquiry, however, will reveal

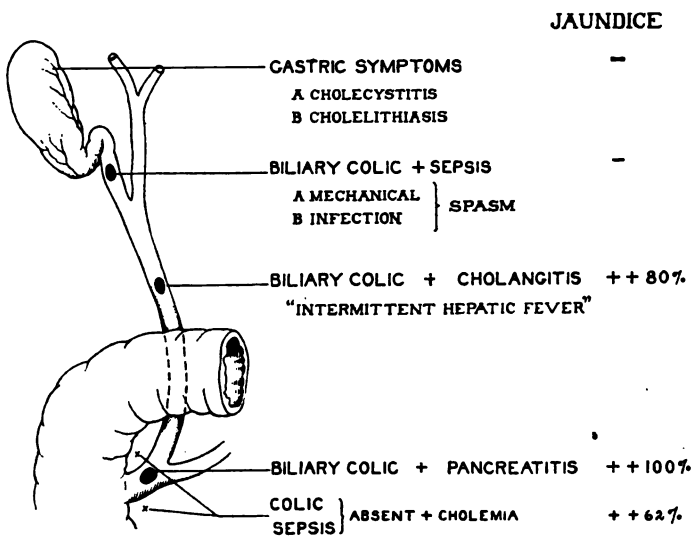

Fig. 219.—Summary of symptomatology in the "four phases" of diseases of the biliary apparatus.

that in the larger proportion of cases (85 to 90 per cent.) there is a history of a colicky jaundice.

The first mechanical factor in calculous obstruction of the common duct is the production of acute biliary obstruction with acholic stools. After a variable period of cholangitis, distention of the duct behind the obstructive calculus occurs, the duct dilates, and the stone floats up into the more ample and dilated common duct, and biliary delivery into the duodenum is resumed.

Between attacks of calculous obstruction of the common

possible, and here perform a primary prophylactic appendectomy. (See technic, chronic appendicitis, pyloric syndrome, appendectomy, page 525.) In this case we find that the cecum is slightly fixed to the right lower quadrant and is somewhat dilated, with marked evidence of a pericolonic membrane. This appendix shows some stasis by reason of the fact that it is kinked at its midpoint and held by the pericolonic adhesions. We will incise the external surface of the meso-appendix, which will allow the appendix to ride free of its retaining adhesions and be delivered out of the abdomen in order to permit a typical appendectomy.

It is almost an invariable rule to remove the appendix in affections of the stomach, duodenum, or gall-bladder. So frequently is the appendix the cause of reflex gastric disturbances that we feel it should be a rule to remove the appendix from the patients when they have in any way complained of gastric disturbance.

Reserving for the last the examination of the field which gave the indication for operation, we find here a gall-bladder chronically diseased. We palpate a number of stones in the gall-bladder. We recognize the adhesions extending down from the gall-bladder to the gastrohepatic omentum, and we now introduce the first and second fingers of the left hand into the foramen of Winslow and carefully palpate the common duct. We do not find the common duct enlarged. The head of the pancreas feels of normal consistency and contour. There are, however, a few adhesions between the under surface of the liver and the hepatic flexure. Withdrawing our hand, we palpate the right kidney, and find it of normal size, shape, and with normal mobility.

It has been found that about 80 per cent. of the chronically infected gall-bladders contain stones; 20 per cent. do not. There are certain unmistakable signs of a non-calculous infected gall-bladder. We have been in the habit of tabulating these signs in the following order: (1) The loss of normal color of the gall-bladder; (2) a thickening of the wall of the gall-bladder; (3) the deposition of saffron-colored fat extending well up toward the

fundus; (4) the presence of organized adhesions between the gall-bladder and stomach or duodenum or colon; (5) the inability to readily empty the gall-bladder by gentle compression; (6) the presence of enlarged glands in the triangle of Calot or along the common duct; (7) visual inspection of the mucous membrane of the gall-bladder by cholecystotomy.

In the last few years a great deal of discussion has taken place whether a routine cholecystectomy should be performed or cholecystostomy. In this clinic we have been removing more and more gall-bladders as our routine surgical procedure. There is something to be said on both sides of the question. The operation of choice can be summed up, however, under the following heads: mortality, curability, morbidity, and general effect upon metabolism. The mortality is relatively the same. If anything, cholecystostomy has a slightly lessened mortality. The simplest cases usually have cholecystectomy, while the graver inflammatory cases are drained, so in 100 cases with drainage of the gall-bladder there would probably be a greater degree of pathologic change than in 100 cases with cholecystectomy. The curability is slightly better with the cholecystectomy, as it is not an uncommon experience to have to reoperate gall-bladders that have been drained.

In non-operated cases there are relatively few deaths from actual disease of the gall-bladder, but there is almost always a long-continued morbidity; 7 per cent. of the cases with gall-stones in the gall-bladder are associated with pancreatitis, and the incidence of pancreatitis rises almost to 70 per cent. in cases where calculi are lodged in the terminal portion of the common duct.

The effect of removal of the gall-bladder upon metabolism is apparently very slight. Under normal circumstances bile is ejected into the duodenum in intermittent spurts, whereas after removal of the gall-bladder bile passes into the duodenum in almost a continuous stream due to the uniform dilatation of the common duct after cholecystectomy from paralysis of the sphincter of Oddi at the ampulla of Vater.

The condition of the gall-bladder in this patient is such that we believe cholecystectomy is the operation of choice.

We introduce our laparotomy pads to protect the adjacent viscera and grasp the fundus of the gall-bladder with a hemostat. Upon making traction the gall-bladder is slightly delivered into the wound. Upon passing the right hand above the surface of the liver toward the dome of the diaphragm we are able to mobilize the liver, so to speak, and allow the right lobe of the liver to be lifted into the wound. This maneuver permits almost the entire gall-bladder to come into the operating field. Hartmann's pouch is now grasped with a second artery clamp and with a scissors the peritoneum binding Hartmann's pouch to the cystic duct is incised. This allows Hartmann's pouch to rise up from the cystic duct and readily allows the cystic duct to be defined for clamping. If there were any possibility of infection of the common duct we would ordinarily drain it through the cystic duct.

We now clamp the cystic duct. There is a very safe procedure for clamping only the cystic duct. Upon taking a curved hemostat we pass it from below upward through Calot's triangle—the space represented by the common hepatic duct, the cystic duct, and the under surface of the liver. After transfixing this clear space the clamp is opened *in situ* and thereby creates an aperture into which is placed a clamp which grasps firmly the cystic duct. A second clamp is placed above and the cystic duct divided between the two clamps. The first clamp may or may not take in the cystic artery. If it does not, the cystic artery is grasped independently. If any stone is found in the cystic duct it is milked back toward the gall-bladder and the clamps inserted below the stone. It is of the utmost importance that these procedures should be done by sight, as the danger to the common hepatic duct or the individual hepatic ducts is by no means negligible, and great care should be taken to prevent injury to these important structures.

After division of the cystic duct or the cystic duct and cystic artery these structures are ligated with No. 2 chromic catgut. Following this the gall-bladder is dissected freely from its fossa and from the under surface of the liver. Occasionally the flap of peritoneum left after excising the gall-bladder is

sutured over with No. 2 plain catgut so as to close in the fossa of the gall-bladder. We now introduce a cigarette drain to Morrison's space—Morrison's space being a purely surgical space represented by the area between the superior pole of the right kidney and the under surface of the liver. The object of this drain is to provide an outlet in case the ligature on the cystic duct "slips-off" and results in a biliary discharge.

Closure.—The abdomen is closed in the typical manner by anatomic reposition of the various layers. The cigarette drain is allowed to emerge at any point in the incision that is most direct to the area operated upon.

Postoperative treatment of this patient will be that of a potential peritonitis, namely:

1. Nothing by mouth for twelve hours.
2. Slight Fowler position.
3. 1000 c.c. of tap-water by rectum with 10 per cent. glucose and 2 per cent. soda bicarbonate added to it.
4. Morphin, gr. $\frac{1}{8}$, p. r. n., for pain or restlessness.

After-result.—The patient had an uneventful convalescence. The cigarette drain was removed at the end of seventy-two hours and the wound dressed on the fifth and tenth days, and the patient was discharged with primary union on the twelfth day after operation.

SWALLOWING OF SMALL HAT-PIN 5 CM. IN LENGTH, WITH PENETRATION OF DUODENOJEJUNAL JUNCTION. EXPLORATORY LAPAROTOMY; REMOVAL OF FOREIGN BODY

Frequency of Children Swallowing Foreign Bodies. Swallowing of Small Beaded Pin Without Symptoms for Seven Days. Ease of Diagnosis with *x*-Ray Examination. Advisability of Surgical Intervention for Removal. Dangers of Laparotomy. Postoperative Treatment.

History.—The patient I am presenting is a girl fourteen years of age. Seven days ago she removed a black-headed pin $2\frac{1}{2}$ inches long from her hair and put it in her mouth. Throwing back her head to listen to something that was being said she took a deep breath and the pin disappeared. She tried to cough it up, but did not succeed. *x*-Ray examination two days after swallowing the pin demonstrated it in the stomach; second examination five days after the accident located the pin in the third portion of the duodenum (Fig. 220). The radiographic examination two days ago showed what appeared to be a glass-headed pin, measuring about $1\frac{1}{2}$ inches in length, the head a little over $\frac{1}{8}$ inch in diameter, situated at the duodenojejunal junction (point downward). This location was determined by the administration of a barium meal. The pin was found to remain in this fixed position on two successive examinations.

The diagnosis in this case is quite easily established, and the sole question before us relates to the advisability of surgical intervention at this time, and also a consideration of some of the difficulties that may be encountered.

This pin has remained stationary in the same location for five days. It resided in the stomach for two days, and then on the fifth day was in the duodenojejunal flexure, and at the end of seven days in the same place.

The sharp end of the pin is pointed downward. It is fair to

assume that the point has probably impinged on or perforated the intestinal wall on account of its stationary position for the past five days.

A physical examination of the abdomen reveals a mild degree of sensibility, but very little spasm or rigidity. The patient has

Fig. 220.—Swallowing of small hat-pin.

been afebrile, but has had a persistent pulse-rate of 100 to 110. We believe that the patient's future will be made safer by an exploratory laparotomy and the removal of this foreign body than by trusting to nature to pass it.

Operation: Incision.—We will make our incision parallel to

the midline, about 4 inches long, 1 inch to the right of the median line, and with the navel on a level with the center of the incision.

The omentum and transverse colon are lifted upward and to the left, exposing the mesocolon. We can see here the beginning

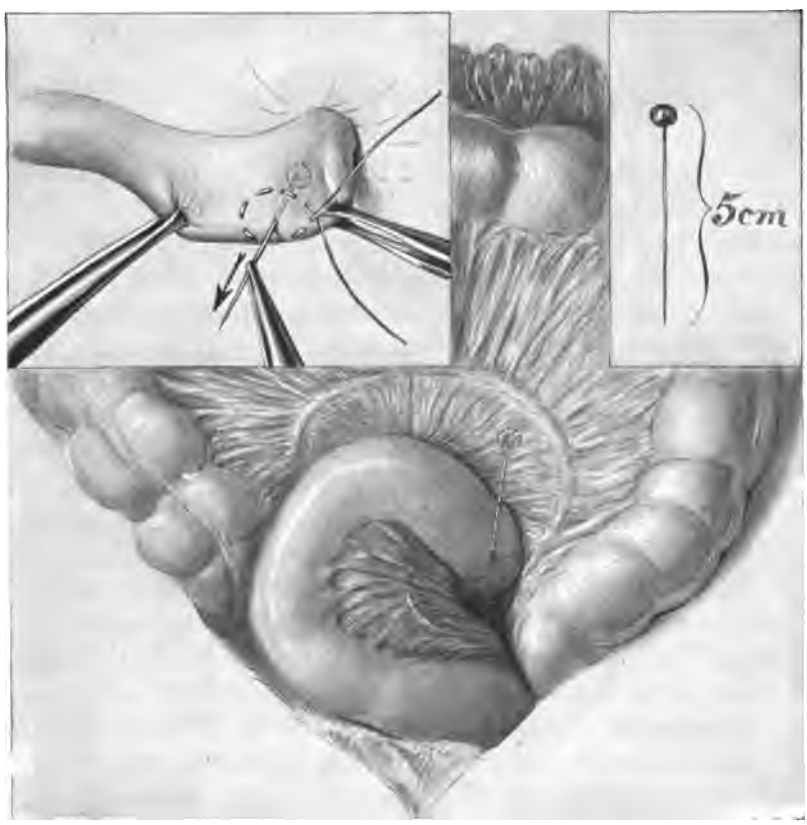

Fig. 221.—Pin in jejunum, 1 cm. of the extremity of the pin perforating the jejunum a short distance beyond the duodenojejunal flexure. *Inserts.*—Left: Purse string previous to withdrawing of pin; right, actual size of pin.

of the small intestine. Upon running the right hand down to the duodenojejunal flexure we feel the sharp end of the pin which is perforating the jejunum about 1 cm. from the angle. We will place a hemostat on the free end of the pin and carefully pull the

pin out until the beaded extremity is held taut within the lumen of the gut. With the pin firmly grasped we can now wall off our area with laparotomy pads, and upon separating the coils of the small intestine and the jejunum we find a small amount of plastic exudate about the area of the angle of Treitz. The perforation has not been of long standing, but is comparatively recent. You notice the hypervascularity of the mesentery and the mesocolon. With our field adequately walled off the pin is held upright and bears a resemblance not unlike the appendix to the cecum. A purse-string suture will now be run around the area represented by the beaded end of the pin much after the fashion of a purse-string in an appendectomy. With this purse-string a loop is held by the little finger of the left hand while the two free ends are held between the thumb and first finger. We shall forcibly pull out the pin, and then invert the aperture made upon removing the pin by means of the purse-string suture, and so make an absolutely hermetic closure (Fig. 221).

I do not believe that the slight kinking from the suture will in any way affect the function of the jejunum. The plastic exudate is left *in situ* and the toilette of the peritoneum completed. In view of the relative lack of infectivity of the contents of the jejunum we will close the abdomen without drainage.

Postoperative Treatment.—The patient will be given the routine treatment for peritonitis: (1) Nothing by mouth, (2) slight Fowler position, (3) Murphy proctoclysis, and (4) morphin sufficient to keep the patient quiet and free from restlessness.

After-result.—Patient was dressed on the fifth and eighth day after operation and discharged from the hospital on the ninth day after operation. Wound in excellent condition.

ACUTE APPENDICITIS; PERFORATION; APPENDECTOMY

Mistakes Made in the Diagnosis of Acute Appendicitis. The Definite Onset of Symptoms and Their Chronologic Sequence. The Causes of Death after Appendectomy. Necessity for Varied Operative Technic Depending on Pathologic Conditions Found. The Importance of Wise and Thoughtful Postoperative Treatment.

History.—The patient I am presenting this afternoon is twenty-four years of age, a tailor, born in Russia, and has resided in the United States for the past eight years. He enters the Post-Graduate Hospital complaining of pain in the right lower quadrant, duration twenty-four hours. The patient states that eighteen hours ago he was seized with a sudden, severe pain, which came on suddenly, was of cramplike character, and confined more or less to the entire abdomen. The pain was quite severe, was associated with restlessness, and at the onset he took "Elax" and vomited soon afterward. This morning the patient took a dose of Epsom salts, which was followed by vomiting. Some time during the night the pain became localized to the right lower quadrant, was of constant character, and has remained unabated up to the present time. Temperature by mouth 99.8° F., pulse 110, respirations 30. A physical examination reveals a uniformly rigid abdomen, respirations of the costal type, with complete immobility of the lower half of the abdomen. The patient is able to focalize his pain with the tip of the index-finger of the right hand to a point 1 inch to the right of the navel and 2 inches below. Upon repeated attempts his localization of maximum pain is very accurate. There is muscle spasm, muscle rigidity, and extreme tenderness over the region of McBurney's point. The pupils react to light and accommodation. The knee-jerks are equal and active.

An emergency blood examination shows 17,400 leukocytes, 85 per cent. of which are polynuclears. Examination of the urine is negative for pathologic elements.

The patient presents a definite sequence of symptomatology, and his symptoms are exhibited in a definite chronologic order. These symptoms are so constant in their essential features as to make an almost uniformly clinical picture of acute appendicitis.

Murphy many years ago emphasized in the most emphatic manner that the chronologic sequence of symptoms of acute appendicitis was practically an unvarying clinical picture.

An analysis of this man's history shows that in the very beginning of his illness he was seized suddenly with pain. There were certain essential features about this pain in regard to locality, mode of onset, character, distribution, and association with other symptoms that are quite distinctive. The pain was of a cramplike, colicky character, was diffused over the area of the epigastrium and navel. The pain came on in paroxysms of great intensity, and yet while suffering intense pain the patient was restless and his suffering was somewhat benefited by movement. This colic was followed by vomiting, possibly brought on by his cathartic, but in any event there would ordinarily follow a sensation of nausea or vomiting, or both. At the end of eighteen hours the patient had a temperature of 99.8° F., pulse 110, and a pain in the right lower quadrant. The original pain has become constant, has lost its colicky character and is associated with abdominal rigidity, spasm, and with a focalized point of tenderness that can be accurately determined with the index-finger of the patient's right hand. In addition, he shows a definite pyogenic blood reaction in leukocytosis and polynucleosis. In view of the patient's marked peritoneal reaction, his intense rigidity, and spasm, we are justified in making the diagnosis of suppurative and possibly perforative appendicitis with localized exudation and peri-appendicitis.

After obtaining the confidence of the patient, if one places the right hand over the lower abdomen and the patient is encouraged to breathe, it is possible to detect a mass that moves slightly on full inspiration and descends beneath the right hand

not unlike the roll of a billiard ball. From this we assume that there is a peri-appendicitis and that the chief guardian of peritoneal infections, the omentum, is doing duty as a protective barrier.

Discussion.—The evolution of acute appendicitis is so definite that it should be one of the acute abdominal inflammations, easy of diagnosis, and with early surgical intervention without mortality. Yet the records of all general hospitals show a death-rate varying from 4 to 6 per cent. These deaths are directly due to failure to diagnose the condition early or failure to recognize its gravity. Surgical postponement and medical procrastination are not infrequently a factor in mortality as well as incorrect or faulty postoperative treatment.

Acute appendicitis has a very definite sequence of symptoms which in their essential character are practically constant and uniform because they are the expression of a very definite pathology. It is only necessary to recall some of the anatomic features of the appendical region and the appendix to understand why acute appendicitis has such a very definite pathologic sequence. The appendix represents a blind tube, and in the adult has the narrowest portion of its lumen at the cecal juncture and known as the valve of Gerlach. It has a strong elastic submucous layer which for a considerable length of time retains the products of infection within the lumen. This elastic submucosa is absent in the appendix of a child and accounts for the variability in the symptomatology of acute appendicitis in children and the marked proneness for the appendix to perforate with extravasation of intestinal contents into the peritoneal cavity. In the appendix and adjacent cecum there is a predominant development of lymphoid tissue which probably represents a protective agency against infection. The arteries of the appendix are essentially terminal, therefore the circulation is rather precarious in the presence of infection and edema. One of the nice points of controversial literature in regard to acute appendicitis is whether perforation precedes thrombosis or thrombosis precedes perforation.

In about 14 per cent. of female subjects there is an accessory

artery connected with the right ovary, and the causal relationship of menstruation with acute appendicitis has been observed many times. The deficiency of the serosa at the mesentery of the appendix renders the appendix most susceptible to perforation at that point. Infection may be said to begin uniformly on the mucosa with the production of turgescence and inflammatory edema. This tumefaction ensues very early and rapidly brings about an occlusion either at the cecal extremity or at some point of angulation of the appendix, and there is an immediate stoppage of intracecal drainage. There follows hemorrhagic infiltration with leukocytic invasion, and the lumen of the appendix becomes distended with pus and feculent material. This condition is essentially an empyema, and the products of an infection are retained under pressure, which means both local and systemic reaction. The symptoms very definitely parallel the pathologic changes, and it is possible to correlate and interpret the pathology by the course and sequence of the symptoms. (See Chart I.)

The initial stage of acute appendicitis represents an infection and irritation within the appendix, and as a result the entire small intestine participates in hyperactivity and hyperperistalsis. The pain, therefore, is colicky in character, of maximum intensity, intermittent, and referred to the zone of the umbilicus. Hyperactivity of the small intestine is followed as a rule by a sensation of nausea or vomiting, or both, and since the mechanical factor producing the pain is hyperperistalsis of the small intestine, we have generalized abdominal sensibility. Infection and its systemic reaction manifests itself in fever and leukocytosis. During the second twenty-four hours one of three processes takes place: (1) drainage of the appendicular contents back into the cecum, (2) gangrene, or (3) perforation. When either of the latter two eventuate the entire clinical picture is changed, and we have a localized abscess in the right lower quadrant from periappendical inflammation and exudation. At this stage the pain is not colicky, but constant in character, with localized tenderness, spasm, and rigidity, with paralysis of the intestines in the attempt to splint or wall off the inflammatory

process. The entire picture then becomes one of localized intraperitoneal abscess.

CHART I

SYMPTOMATOLOGY OF ACUTE APPENDICITIS

EVOLUTION OF SYMPTOMS PARALLELING PROGRESSIVE PATHOLOGIC CHANGES IN THE APPENDIX

First twenty-four hours.	Twenty-four to forty-eight hours.	Forty-eight to seventy-two hours.
1. Pain: Colicky, Epigastric, Intermittent.	1. Pain: Not colicky, Confined to R. L. Q., Constant.	1. Pain: Not colicky, Confined to R. L. Q., Constant.
2. Nausea or vomiting, or both.	2. Rarely vomiting.	2. Vomiting usually absent.
3. Generalized abdominal sensitiveness.	3. Tenderness in R. L. Q., Spasticity.	3. Tenderness in R. L. Q., Spasticity.
4. Temperature +.	4. Temperature 101°–103° F.	4. Temperature normal to 104° F.
5. Leukocytosis and polynucleosis.	5. Leukocytosis, increasing polynucleosis.	5. Leukocytosis and polynucleosis.
		6. Tumor or induration.

Acute appendicitis provides us with some very interesting blood counts, and the latter within certain limits offers a diagnostic aid and a prognostic agent of no mean value. In interpreting leukocytic reactions to acute infections we must have in mind a basic standard, and accordingly, we assume that the greatest number of leukocytes that may exist in any normal condition is not in excess of 10,000 per c.mm., and that the greatest number of polynuclear cells present in any condition of health does not exceed 75 per cent. We may take the total count as an index of a patient's resistance to infection, and we may take the percentage polynuclear count as an index of the virulence or severity of the infection.

Gibson a number of years ago devised a chart to portray graphically this relationship between polynuclear percentage and leukocytosis. Under conditions of normal resistance in inflammatory lesions which are well borne the polynuclears are increased 1 per cent. for every addition of 1000 to the gross leukocyte count. This can be indicated schematically:

CHART II

Gross leukocyte count per c.mm.	Percentage of polynuclears.
10,000	75
15,000	80
20,000	85
25,000	90
30,000	95
40,000	100

Under normal conditions of health the white cells are uniformly distributed throughout the body—in the connective tissue and in the circulation. Sondern, analyzing the blood counts in a large series of cases of acute appendicitis, was able to catalogue the results into three groups, and to deduce certain pathologic conditions from the general grouping of the leukocytes and polynuclears. Sondern's grouping may be stated briefly as follows: group 1, leukocytosis of any degree and a polynuclear count below 70 per cent. would exclude gangrene or pus; group 2, a leukocytosis of slight degree and a polynuclear count over 80 per cent. would indicate rather severe infection with slight resistance; group 3, a large leukocyte count and a polynuclear count over 85 per cent. would seem to suggest the presence of gangrene or pus.

In this patient we have made the diagnosis of acute appendicitis, and we find that he has a gross leukocyte count of 17,400, which points to a fair degree of resistance upon the part of the body, and a polynuclear percentage of 85, which points to a rather virulent infection, which makes the presence of pus or gangrene probable.

Operation: Incision.—The incision that we use in doing an appendectomy begins about 1 inch below the level of the navel and 1 inch to the right of the median line and extends downward 3½ to 4 inches, curving slightly inward toward the median line. The anterior sheath of the rectus muscle is divided and the rectus muscle itself is split in the longitudinal direction. Occasionally we injure the veins accompanying the deep epigastric artery, but if one recalls that these vessels are in the properitoneal fat they can be displaced to one side by gently wiping the fat

with a piece of gauze and so lessen the possibility of injury to them. Great care is taken in entering the peritoneal cavity on account of the possibility of injury to the intestines lying beneath. We find the omentum lying beneath the incision and enclosing the cecum very much as the palm of the hand would enclose a billiard ball, and representing a protective barrier against the spread of infection. We proceed to separate the omentum and find some free lymph-like material. This fluid is not ordinarily infectious. Quite the contrary, it is a reactive fluid, an exudate from the peritoneum, and is essentially a protective product. It is found quite early in the more severe cases of infected appendices.

We find that the appendix is ruptured on its mesenteric border and there has been an extravasation of intestinal contents. We see escaping from the mass a few drams of creamy, yellow pus of a distinctly colonic odor. Upon continuing the separation of the omentum we see that the appendix has participated in an acute inflammatory process with perforation at about the midpoint. The proximal portion is edematous and swollen, but still capable of being inverted. The meso-appendix is very carefully ligated, extreme care being necessary on account of the infiltrated character of the meso-appendix. Close to the cecum the appendix is crushed with a hemostat, and in the crushed area the appendix is ligated with No. 2 chromic catgut. The effect of the crushing of the appendix is to destroy the mucosa and so more readily close off the lumen of the appendix after it is inverted.

We now begin our purse-string suture of Pagenstecher thread at a point directly opposite to us. The passing of the purse-string stitch may be made more intelligible by taking the caput of the cecum as the dial of a watch, and we begin our purse-string at what corresponds to 12 o'clock and penetrate the serosa of the cecum at 10, 8, and 6. At 6 o'clock a small loop is left free and the purse-string continued up at 4 and 2, and finally again at 12. The two free ends of the purse-string are tied with a single knot which is run down close to the cecum and which represent the beginning and ending of the purse-string

loop. These two ends are grasped in the thumb and first finger of the left hand and the loop is placed over the little finger. A piece of gauze is now laid under the appendix, and then distal to the crushed, ligated area of the appendix a hemostat is placed to keep the contents of the appendix from running free upon cutting. Between this clamp and the ligature the appendix is divided and the gauze, clamp, and appendix removed in one piece. The tip of the stump of the appendix is freely touched with pure phenol on a cotton applicator, and using the other end of the applicator the stump of the appendix is pushed into the center of the purse-string. When the stump has clearly disappeared beneath the level of the cecum the loop on the little finger is released and upon pulling the two ends of the ligature between the thumb and first finger the stump is completely inverted within the infolding peritoneum of the cecum. (See Figs. 210–217.)

On account of the free pus in the right lower quadrant of this patient's abdomen it will be necessary for us to introduce a rubber tissue drain down to the area of greatest inflammatory reaction. If the patient's pulse remits, temperature drops, the drain may be removed at the end of thirty-six hours, and should make very little difference in the ordinary healing of his wound.

Postoperative Treatment.—Death in acute perforative appendicitis is not infrequently due to faulty or incorrect after-treatment.

If you consider that the surface area of the peritonuem equals that of the surface area of the body, and that the peritoneum is capable of absorbing about 5 per cent. of the body weight in an hour, we can understand the tremendous additional absorptive power of an abraded, injured, inflamed, or infected peritoneum. It has been found that the rate of absorption within the abdominal cavity varies with the anatomic location. Absorption is most rapid in the area of the diaphragm, less so by the omentum, by the visceral peritoneum, by the parietal peritoneum, and least by the pelvic peritoneum.

The guiding principle of our postoperative treatment in acute peritoneal infections is to prevent a local peritonitis from be-

coming general and to employ all measures that will diminish the rate of peritoneal absorption. We may therefore define a routine postoperative treatment embracing the following: (1) Adequate surgical intervention and drainage of the area of infection; (2) nothing by mouth, not even water; (3) Fowler position—at least an elevation of 30 to 35 degrees; (4) the introduction of ordinary tap-water by Murphy proctoclysis; (5) maintaining an empty stomach, employing gastric lavage if necessary; (6) to control restlessness or pain by the use of morphin.

We no longer employ the normal saline solution for proctoclysis because it has been conclusively demonstrated that the saline has no advantage over the ordinary tap-water and has many distinct disadvantages. A patient can absorb plain water over a longer period of time, with less rectal irritation; can take more plain water with less thirst after the termination of the proctoclysis; has less nausea with plain water than follows proctoclysis with normal saline. One has only to recall the cases that have exhibited edema of the eyes and legs and the occasional acute edema of the lungs that have followed the use of too long-continued proctoclysis of normal saline to see the advantage of plain water over normal saline solution.

One of the most important signs of diminishing peritoneal reaction is the falling pulse-rate, and when the pulse-rate declines to 100 or less we have considered it reasonably safe to give fluids in small quantities by mouth. We refrain from giving cathartics by mouth for a longer period of time, contenting ourselves with cleansing the lower bowel daily with an enema of not more than 700 to 1000 c.c.

After-results.—The patient was dressed at the end of forty-eight hours and the rubber tissue drain removed. His temperature dropped to normal at the end of the third day, when he was placed upon soft diet. His wound and subsequent convalescence were uneventful and he was discharged from the hospital on the afternoon of the thirteenth day.

CLINIC OF DR. BYRON STOOKEY

NEUROLOGICAL INSTITUTE

BRACHIAL PLEXUS INJURIES

RUPTURE of the brachial plexus occurs not only in infants during childbirth, but in adults as well. In both the injury is the result of mechanical forces similarly applied, and both show similar pathologic lesions in the nerve trunks of the plexus as well as similar paralyses. Stab wounds and gunshot wounds, while less frequent, are not uncommon, since the plexus is in a relatively exposed position in the posterior triangle of the neck, and does not receive the protection usually afforded structures of such importance.

In lesions so readily demonstrable as those found in obstetric paralysis it seems strange that there should be two opposed views concerning the pathologic changes encountered, some claiming that the deformity is primarily bony, involving the shoulder-joint; others, that the injury is primarily to the nerve roots which form the brachial plexus. As the result of these two variant opinions an attitude of *laissez faire* has been adopted, and often nothing is done for the infant. Generally the mother is told that the paralysis will disappear in time. No doubt a few of the lesser injuries recover untreated, yet the more severe do not.

Depending upon the exact location of the injury, great variation in the paralyses will be found because of the anatomic complexity of the brachial plexus, consequently, a thorough knowledge of the plexus and a minute examination are required if an accurate localization is to be made. We shall attempt to reach an accurate localization in these 2 cases of brachial plexus injuries—one a stab wound and the other an obstetric paralysis.

CASE I. STAB WOUND OF THE BRACHIAL PLEXUS

The first case I wish to show is a negro, twenty-five years old, who was stabbed in the left supraclavicular region in a "social" quarrel over a colored girl. The patient states that without warning, as he attempted to pass his rival on the stairs, the latter suddenly stabbed him with a knife. The negro asserts that the knife was "at least 8 inches long." The knife entered the neck on the left side about 3 cm. above the clavicle, and immediately the left arm fell limp, with tingling in all five fingers. There was considerable bleeding, and the patient was taken to an emergency hospital, where the wound was dressed. No surgical interference was undertaken. The patient's arm was placed in a sling, and he reported for daily dressings to the outpatient department for a period of about three weeks.

During this period of three weeks his arm was carried in a sling and no other mechanical treatment was given. The patient was told that in a few weeks more he would regain the use of his arm.

The injury to this patient occurred two months ago. Judging from the history of immediate paralysis and what we still find, there has been no improvement in his condition. He is unable to raise or to bend his arm, though he says his grasp, now as always, is good. During the past few weeks there has been some pain radiating down the other side of the arm and in the region of the scar. The pain is made worse by any movement which causes pressure upon the scar, such pressure producing exquisite pain both locally at the site pressed and in the arm. During the past two months the patient has been receiving massage and faradic electricity, which he does not think has caused any change in his condition. He was referred three days ago for a neurosurgical opinion as to whether or not an operation was indicated.

Before beginning the examination there are one or two points in the history to which it might be well to call attention. In the first place, any stab wound such as this, obviously involving the nerves of an extremity, giving an immediate and complete flaccid paralysis of one or more of the nerves or nerve roots,

should be *explored* at the time of repair of the primary wound. If at this time the nerves are found to be severed or partially severed, repair of the nerves should be undertaken at once. Such repair, when done at the primary operation, is called primary suture.

End-results of primary nerve suture are better than those of secondary suture.

On the other hand, if the nerves are found in anatomic continuity, even though they may appear traumatized, the *most rigid conservatism* is demanded. Such nerves at *primary exposure* should be left undisturbed. No surgeon, however careful or skilful, is able to reunite two nerve ends without some loss or dispersion of the neuraxes in the paths of the nerve trunk. At primary operation in these cases a careful toilet of the field should be made, and the surrounding tissues repaired so as to minimize scar formation and, as far as possible, prevent scar invasion of the traumatized nerve trunks, in this manner facilitating nerve repair. In this case, even though an obvious injury of the brachial plexus was indicated, not only by the paralysis but by the site of the injury—namely, the posterior triangle of the neck immediately over the plexus—nothing was done to investigate the plexus or repair the nerve injury.

The second point in the history to which I wish to call your attention is the fact that though there was a recognized paralysis, no adequate splinting was given to the patient in order to relax the paralyzed muscles. Mechanical support of paralyzed muscles is an axiom in the treatment of nerve injuries. In order for a splint to be effective it should overcome all deformities, or at least the principal ones. It should prevent contractures of the opposing muscles, afford relaxation of those paralyzed, and yet not cause fixation. Concerning the proper mechanical treatment we will speak again later.

Examination.—As you well know, the examination of nerve injuries is necessarily long, and requires thorough investigation of many details, not only of the local injury but also the motor paralysis, the electric changes, and the alteration in the sensation of the affected part. Unless such an examination is com-

plete, neither exact localization of the injury is possible nor its extent, nor whether or not recovery has begun. These are all important points. It would be obviously unwise to operate when regeneration is progressing; or, on the other hand, to operate at a level at which there is no injury to the nerve. Generally speaking, neither the motor nor the sensory examination alone suffices, but both should be made in order to interpret accurately.

Local Examination.—We see here at the posterior triangle of the neck a scar, rather wide for a stab wound—about 3 x 5 cm. —having obviously been the site of former suppuration. The scar is deeply adherent and is not freely movable, being apparently adherent to the tissues within the depth. It would appear that the scar extends inward approximately 3 to 4 cm.; this is a thin individual, and this depth is sufficient to involve the upper cords of the brachial plexus. We notice that the patient winces each time the scar is handled, and the pain, he tells us, is not only local at the site of pressure, but is referred down the arm, especially on the outer side of the arm. The scar seems dense and no pulsation or thrill is felt. While the injury is a little higher than the arch of the subclavian, it is always well to consider in this region a traumatic arterial aneurysm. By auscultation nothing is made out, and this is further confirmed by comparing the blood-pressure of both the right and left arms. In each instance the record shows us the systolic to be 130 and the diastolic 90. Absence of a palpable thrill, of characteristic bruit, as well as equality of blood-pressure in both sides make aneurysm improbable.

Here, then, is a local wound which from the history we may infer involves some part of the brachial plexus. Furthermore, the wound is so placed as to be over at least the upper two roots, and the referred pain on the outer side of the arm would seem to indicate their implication.

Motor Examination.—Let us see what movements the patient is unable to accomplish. We notice that he cannot flex the forearm upon the arm; he is unable to elevate the arm in either the lateral or the frontal plane. Adduction, on the other hand, is apparently normal, as is also internal rotation, while true ex-

ternal rotation is not accomplished at all. The external rotation, you see, is, in reality, a pseudosupination. Apparently flexion and extension of the fingers and wrist are unimpaired, as are also the movements of the fingers. Thus we have seen the total movements which the patient can perform.

The information thus gained may be of immense value providing you are familiar with each movement and the component muscles involved in each phase of any such total movement. However, the only reliable motor information is gained not from total movements, but from a study of the action of *each individual muscle.* The action of any one muscle may drop out, and yet a total movement may be performed either by the remaining muscles of the group or by the action of new muscular combinations. This Létiévant (1872) termed "mouvements supplées." A great variety of such movements were described by him, and of such movements we must be aware if we wish to place reliance upon the information given by total movements.

Individual Muscle Action.—We will now try out the motor function of each individual muscle of this extremity. We will begin with the deltoid. The patient is unable to elevate the arm in abduction more than is done by the action of the scapula which, in attempting to co-operate in the elevation of the arm, undergoes rotation. This rotation of the scapula occurs as the initial movement in elevation of the humerus, and it is to this rotation of the scapula that the slight abduction of the humerus which you see here must be attributed. The patient is unable to elevate the humerus further, and the hand palpating the deltoid finds it flat and flaccid, without any appreciable trace of contraction.

It is interesting to note in this connection that the usual text-book description of the action of the deltoid is not that which we now understand this muscle to have. In elevation of the humerus there are really two component cycles of movement: (1) rotation of the scapula and (2) elevation of the humerus. We are taught that the deltoid elevates the humerus to a right angle, but this is not really the case. In elevation of the humerus, first rotation of the scapula occurs, approximately

5 or 6 degrees. Following this, the deltoid elevates the humerus to about 60 degrees; and *from 60 to 115 degrees elevation is accomplished principally by the action of the scapular muscles;* following which, elevation is completed to 180 degrees, that is, to the vertical position by *active participation of the deltoid*, especially the clavicular head. This action of the deltoid in the elevation of the humerus from 115 to 180 degrees has heretofore been ignored, although it is a very important part of its function.

We will now test adduction. As the patient attempts to draw the arm inward toward the body we offer resistance and at the same time palpate the tendons of the teres major and the pectoralis major. These contract and appear to be normal. The patient now attempts to draw the arm inward and forward across the chest, thus testing further the action of the pectoralis major. This movement is readily accomplished, and the pectoralis major, you notice, is definitely contracted; but if you are careful in your examination you will see that the clavicular head of this muscle does not participate—only the sternal portion is contracted, the clavicular being flaccid and apparently atrophic. *The clavicular head* of the pectoralis major is paralyzed.

We will now test the external rotators, namely, the supraspinatus and infraspinatus. Neither of these muscles contracts and no true external rotation takes place. We notice the hollow both above and below the spine of the scapula, which indicates their atrophy.

Next, we will test the biceps. Flexion of the forearm is impossible and, as you see, this muscle belly remains flabby. It is completely paralyzed, is atrophied, and has lost its tone.

We will next test the supinator longus. This muscle is poorly named, for it is very little a supinator and very much a flexor of the forearm. If in a normal individual the forearm is held semiflexed and the patient is told to continue flexion, this muscle will rise as a distinct band, forming the lateral boundary of the elbow. In this case no such muscular band is made out, and the semiflexed elbow is seen to be without its usual lateral boundary, nor does any flexion take place. The supinator longus is paralyzed. I have seen excellent men fail to recognize a biceps

paralysis because the patient was able to flex the forearm sufficiently well upon the arm by means of the supinator longus without the loss of the biceps action being detected. This flexion action of the supinator longus must not be forgotten.

Next we will try the triceps. Here extension of the forearm is performed, but there is some obvious weakness, particularly noted by comparison with the sound side. The coracobrachialis muscle can be made to contract and palpated by having the patient attempt to raise the arm into the gun position. While this position cannot be accomplished in this patient, due to paralysis of other muscles, contraction of the coracobrachialis can be distinctly made out.

In the forearm: The flexors of the wrist on both the radial and the ulnar side are distinctly felt; especially are they made out over their tendons at the wrist, where with some practice most of them may be fairly accurately identified. The flexor carpi ulnaris shows normal contraction, and the action of the palmaris longus is readily demonstrable.

We note then, in summarizing our motor findings, paralysis of the following muscles: Deltoid, clavicular head of the pectoralis major, supraspinatus, infraspinatus, biceps, supinator longus, and weakness of the triceps.

Obviously such an extensive lesion cannot be explained by injury to any one peripheral nerve, nor can it be attributed to a lesion of the secondary cords. The site of an injury involving such a distribution—including as it does muscles supplied by the suprascapular nerve, the external anterior thoracic, the musculocutaneous, the circumflex, and *part* of the musculospiral—can only be accounted for by some injury to the brachial plexus proximal to the formation of the secondary cords. Injury to any peripheral nerve would involve only muscles in the distribution of that nerve; injury to any of the secondary cords—unless nearly all are involved—would generally show a distribution corresponding to two or more nerves, while this distribution corresponds to five. Furthermore, a lesion of the secondary cords could not explain paralysis of the clavicular head of the pectoralis major or paralysis of the supra- and infraspinatus, since the nerve

supply of these last two muscles comes off the brachial plexus before the formation of the primary outer cord, or immediately at the junction of the fifth and sixth cervical roots.

Thus, considering the information given by the local examination of the site of the injury and the motor distribution of the paralysis, the lesion in this case must be placed in the fifth and sixth cervical nerve roots proximal to the point, or at the point at which the suprascapular nerve is given off. The lesion does not extend to the seventh root, since the coracobrachialis muscle is not paralyzed. This muscle, you will recall, is supplied by a separate nerve, the nerve to the coracobrachialis muscle, which arises from the seventh cervical and passes *along* the musculocutaneous nerve to the coracobrachialis; the musculocutaneous nerve, on the other hand, arises from the fifth and sixth cervical, while the nerve to the coracobrachialis which accompanies it arises from the seventh cervical.

The lesion in this case, however, is not complete, that is, the anatomic continuity of the fifth and sixth roots has not been interrupted, since certain muscles completely or partially supplied, though not invariably, through the fifth and sixth are not paralyzed nor is there any weakness in them. They are the palmaris longus, the flexor carpi radialis, and sometimes the superficial muscles of the thenar group.

Electric Examination.—This has already been made, and the report shows that there is no faradic response in the muscles which we have already designated as paralyzed. There is no reaction of degeneration.

This information confirms the motor examination. However, it must be recalled that frequently a muscle which has regained its power of contraction following paralysis may not show a return of faradic irritability until long after return of voluntary motion.

In spite of the information already gained, the examination of this case is not complete until a sensory investigation has been made. Here is the chart of the sensory changes found in this patient (Fig. 222). There are two lines, an outer and an inner. Both lie over the deltoid, but do not completely overlie the del-

toid area. The outer line indicates the loss to cotton wool, while the inner and smaller area shows the loss to extreme degrees of temperature and to pin prick. The area you see outlined is the only one in which any anesthesia has been found. None was made out below the elbow corresponding to the sixth root distribution. This area, you see, does not correspond to the

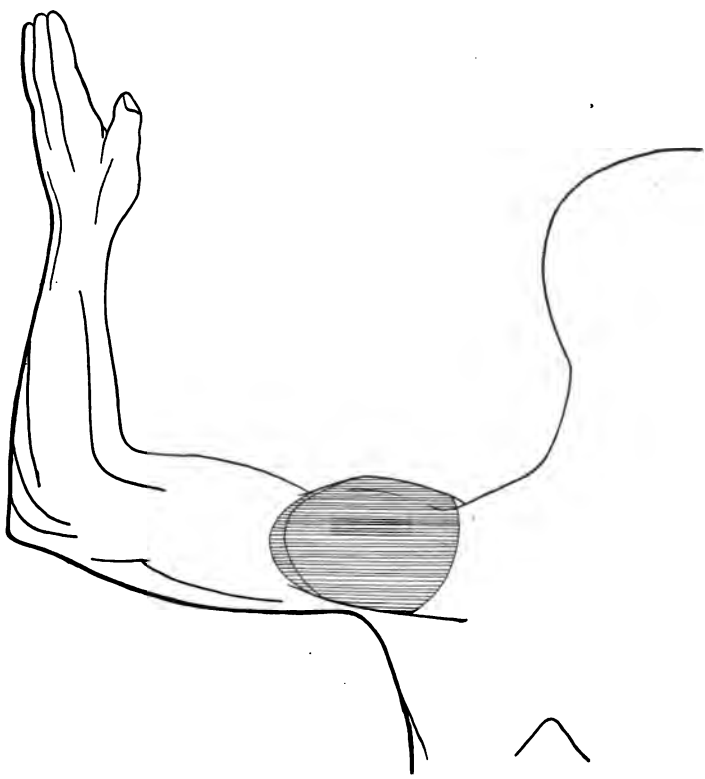

Fig. 222.—Chart showing loss of sensation as found in Case I. This area corresponds approximately to the distribution of the fifth cervical root.

area supplied by the circumflex nerve, in that it is very much smaller than the usual cutaneous distribution of this nerve. The circumflex nerve arises from the posterior divisions of the fifth and sixth, and contains sensory fibers from both, though mainly from the sixth. Since this area does not correspond to the circumflex, but more to the contribution in the circumflex

of the fifth cervical root, we may infer that some fibers of the sixth cervical root remain uninjured, especially since no changes were found in the area belonging to the sixth root.

Thus the sensory findings substantiate the conclusion reached in the motor examination, namely, that the lesion of the fifth and sixth cervical roots is not complete and involves mainly the fifth. Further evidence of the incompleteness of the lesion is found in the referred pain which is elicited by pressure over the scar. The patient outlines consistently an area of referred pain which roughtly corresponds to the sixth distribution. Referred pain of this character is not found in complete nerve lesions.

Our diagnosis, then, is an incomplete lesion of the brachial plexus involving the fifth and sixth cervical roots, proximal to or at the point at which the suprascapular nerve is given off.

Judging by our examination of the local injury, it is only fair to assume that the roots are involved in the deeper portion of the scar which we here see superficially.

Operation.—A longitudinal incision 4 inches long is made over the site of the injury. A longitudinal incision is made so as to permit of a more extensive exposure of the plexus, if such is called for. I am now excising the superficial scar so as to exclude it from the line of closure. Scar tissue delays primary union and is apt to slough. As I dissect further, a small muscle belly is seen running transversely across the field. This is the posterior belly of the omohyoid. This muscle is now pulled aside and the transverse cervical artery and vein are exposed. We pass a ligature around each and cut both artery and vein. I am now passing two sutures through the omohyoid and shall cut between them. These sutures serve as hemostatic muscle sutures, preventing bleeding from the cut muscle ends. The muscle is now cut transversely, and these two sutures will be used to reunite the muscle when closing the wound. I can now identify the scalenius anticus and scalenius medius muscles. Between these the plexus should lie (Fig. 223).

As I clear away the fascia the upper cord presents. I am working above the site of the injury. It is always better to isolate the structures either above or below, and then dissect down

through the scar. As I dissect deeper, the sixth cervical cord is seen. I have my finger on it. The scar is at the union of the fifth and sixth roots. I am dissecting laterally now to find the suprascapular nerve so as to trace it inward through the scar and thus avoid damaging it, as I might do if I hunted for it in the scar. Here is the suprascapular nerve. As I dissect it to its

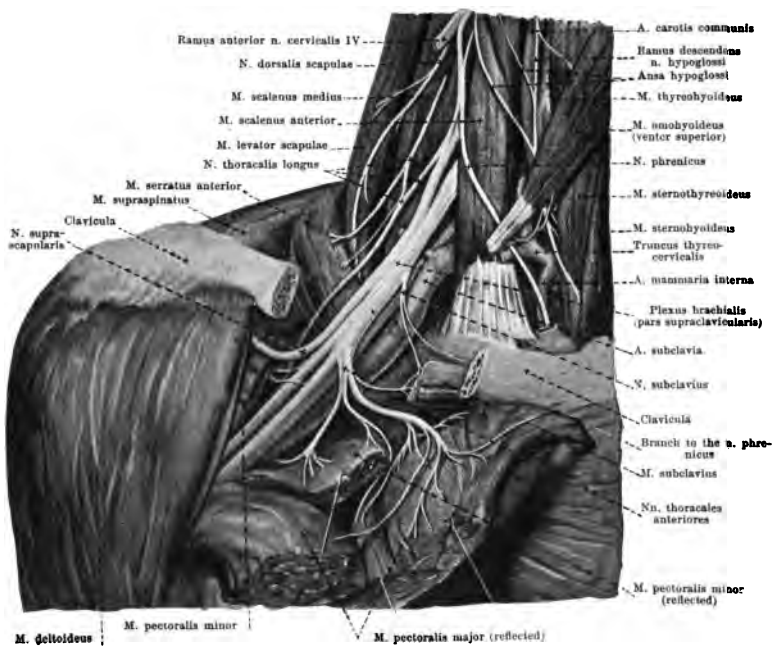

Fig. 223.—Right plexus brachialis with its short branches, viewed from in front. The sternocleidomastoideus and trapezius muscles have been completely, and the omohyoideus and subclavius muscles partially, removed; a piece has been sawn out of the clavicle; the pectorales muscles have been incised and reflected (Spalteholtz).

origin, it is seen involved in the scar. I am now dissecting the scar tissue from the nerve trunks. The fifth root is more involved than the sixth. The fifth is somewhat contracted by the scar, though anatomic continuity is not broken. The suprascapular nerve is more damaged than the fifth root, and the fifth more than the sixth. This is tedious dissection. Each stroke is most cau-

tiously done. Speed is not an asset at such times. Care must be taken to injure as little as possible; the nerve trunks must not be handled.

The scar is now free from both the ventral and lateral aspects of the fifth and sixth roots. We shall now test with the electrode. Slight response is obtained in the biceps; none in the deltoid. With the patient lying on his back, it is difficult to determine if there is any response in the supra- and infraspinatii muscles. In view of the recent injury (two months old) and the anatomic picture we have here, it is best to be conservative. We will inject salt solution under pressure into the nerve trunk, thus freeing the individual funiculi. This is called internal neurolysis.

The field is cleared of scar as much as possible; where we have not been able to excise, we have infolded it upon itself. In some instances this is better than excision. Due to the localization of the injury, namely, in the neck, where in this man there is little or no fatty tissue to serve as a fat pedicle to transplant in order to wall off the scar, we shall surround the nerve with Huber's cargile membrane. A free fatty transplant serves only to increase scar and should not be employed. Huber's membrane is ordinary Cargile treated with alcohol. Huber, Professor of Anatomy at the University of Michigan, found that such membrane remains in the tissues five or six months without being absorbed, and that it is borne well by the tissues without causing any increase of scar; whereas ordinary membrane is readily absorbed, remaining in the tissues about as long as catgut. Huber's Cargile membrane, I believe, has a great field of usefulness not only in neurosurgery, but in other fields as well.

Had I done nerve suture and thus removed the injured portion of the nerve, no form of protection at the line of union would be necessary. The field is now dry—this is a very essential point—and we are now closing the wound in layers. Dressing is applied, and we are now ready to put on the splint, which has already been made and fitted to the individual (Fig. 224).

This splint aims to overcome the deformity which results from this injury. The arm is abducted above a right angle in

order to relax the deltoid; the forearm is slightly flexed and held in external rotation, thus relaxing the biceps and supinator longus, and the arm is held in external rotation, overcoming the tendency to contraction of the internal rotators. The arm will be held essentially in this position until some evidence of regeneration has shown itself.

We have done nerve liberation and not nerve suture. If no improvement is shown within two months after nerve liberation, this generally means that nerve suture should have been done instead of liberation. However, since there is no way of deter-

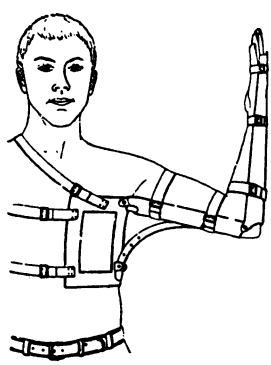

Fig. 224.—Adjustable abduction splint with adjustable forearm piece for paralysis of the fifth and sixth cervical nerves. The arm is held in abduction and *external rotation* with the hand in supination. By altering the pin and lever to the arm-piece, the arm can be held in any desired angle of abduction. Forearm piece may also be adjusted by screw lock to various degrees of flexion. The splint is made of aluminum and lined with felt.

mining with certainty which should be done, we can only rely upon our own judgment—the result of seeing a great many such conditions—and, now that we know the condition of the nerves, wait two months for some evidence of regeneration. This can be done without any great injury to the patient. If our judgment has been correct, we will have saved him a year, since regeneration following suture can hardly be expected in less time. In the meanwhile we shall see that massage and galvanic current are given, and that neither contractures nor overstretching of the paralyzed muscles occur.

Note.—The patient left the hospital in ten days. The wound healed by first intention. Four weeks after operation some evidence of regeneration was seen, and in four months function had returned in all the muscles except the supra- and infra-spinatii. A second operation will be done on the suprascapular nerve to try to obtain innervation of the external rotators.

CASE II.

This is an infant, two years old. Normal labor; no instruments; head presentation. Since birth it has been unable to use its left arm. The fingers move and also the wrist, but flexion of the forearm or elevation of the arm is impossible. The child was seen by several physicians after birth, one of whom told the mother to do nothing; and the other, that the injury was to the shoulder-joint and that the condition would gradually improve. After six months the mother took the child to one of the neighboring cities where, among other things done, an *x*-ray was taken, but nothing was found. The consultant advised her to wait and return again in six months. The mother brought the child to me six months ago, that is, when both the child and the injury were eighteen months old.

Examination of the child at that time showed a typical Duchenne-Erb palsy, the arm being limp at the side, with inability to raise it in either the horizontal or frontal plane. The whole arm and forearm were turned inward, and the palm faced backward and outward. This position is characteristic of the Duchenne-Erb palsy. Slight subluxation of the shoulder-joint was present. *x*-Ray of the shoulder showed nothing abnormal, except that the coracoid process seemed larger and curled downward. Stereoscopic examination showed subluxation with the head drawn backward.

The mother at the time was desperate and insisted that something definité be done. In view of the fact that the paralyzed muscles had always been overstretched and had never been relaxed by any mechanical treatment, the arm was put up in a splint similar to the one which you have seen in the previous case (Fig. 225).

It is well known that paralyzed muscles may not regain their contractility when they have been continuously overstretched, even after nerve regeneration, but may again recover their power after a prolonged period of rest and relaxation. In this case the aim has been to maintain this position—which you see here—constantly for six months, except when massage has been given, which has been done twice daily. The arm has been put through a series of passive motions to prevent contracture and to exercise the muscles. This treatment has served to im-

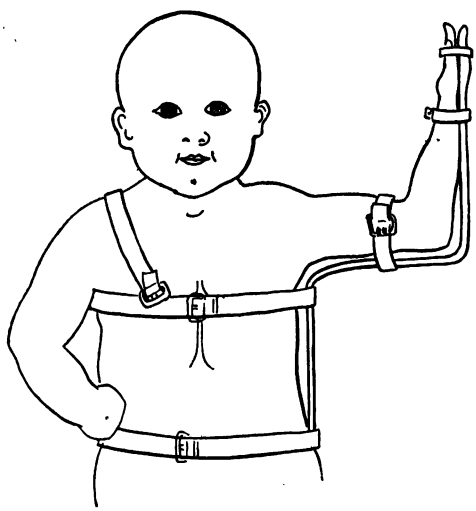

Fig. 225.—Another splint for brachial plexus injuries of the Duchenne-Erb type. Note that the splint is carried down to the pelvis so as to have its main point of pressure there. This splint may be made of aluminum. It is exceedingly light and simple.

prove the nutrition of the part; the arm looks larger and is generally in better condition. The mother thinks there has been some improvement. However, this is slight.

In this connection I should like to say that no brachial plexus injury should be allowed to go without mechanical treatment designed, as far as possible, so as to prevent contracture and overstretching of the paralyzed muscles. When such treatment has not been given, no operative intervention should be

undertaken until an opportunity has been afforded the overstretched muscles to regain their contractility by a prolonged and continuous period of relaxation.

I have at the present time 2 cases—one four and the other five years old—which had been untreated until they came under my care less than a year ago and which now have regained, as the result of mechanical treatment alone, 80 to 90 per cent. of function which was lost when first seen. This is all the more noteworthy, since in the one instance nothing had been done for three years and in the other for four, and goes to show that regeneration may take place, but re-establishment of contractility may not occur unless relaxation has been afforded the overstretched muscles. In both of these cases there was typical Duchenne-Erb palsy involving the fifth and sixth cords. In both the splint applied was similar to the one you have seen. Massage and passive exercises were done twice daily. Improvement began in one case in four months, and in the other in five. The patients have now worn their appliances nearly a year and have regained the function of nearly all of the paralyzed muscles with the exception of the external rotators and the radial flexors of the wrist. If improvement does not occur in the external rotators, an operation will be done to overcome this paralysis by implanting the suprascapular nerve or by reunion of the ends of the suprascapular nerve by means of a nerve-graft.

Both of these cases illustrate the value first of obtaining relaxation of the paralyzed muscles before undertaking any operative procedure, no matter what the interval may have been between the injury and the first observation.

In this case before you we have given the muscles six months of rest without any marked improvement. Further mechanical treatment I do not believe would be productive of any more improvement, and operative interference now offers the best chance. The present examination of this child shows the following:

The arm hangs limp at the side. There is marked atrophy of the entire extremity. The coracoid process is prominent and the head of the humerus is slightly subluxated dorsally. The

fingers are seen moving in flexion and extension. The wrist is slightly adducted and the forearm is rotated inward, as is also the humerus. The palm of the hand is turned backward. The child is unable to raise the arm or to flex the forearm. If the forearm is flexed, it is unable to extend it. There is marked atrophy of the deltoid, biceps, and supinator longus; and there is some atrophy of the radial flexors, though it is not possible to determine precisely which muscles are involved. In an infant it is almost impossible to examine the individual muscular action; the information on the motor side must be gained by prolonged and repeated observation of the movements performed. The sensory examination is also of little value. For accurate sensory examination co-operation of the patient is essential. Obviously, this is impossible in an infant.

The electric examination shows no faradic response in the deltoid, biceps, or supinator longus. The examiner reports that further electric examination was impossible, since he was unable to determine with accuracy the response in the smaller muscles.

Analysis of this case shows then the following: Paralysis of the deltoid, supra- and infraspinatus biceps, and supinator longus, with some weakness probably of the radial flexors of the wrist and fingers. Such a lesion can only be accounted for by injury of the fifth and sixth cervical roots above the clavicle.

The seventh is not involved, since there seems to be little weakness of extension. The eighth cervical and first thoracic are not implicated, since the movements of the fingers and the shape of the hand show no paralysis or atrophy. Further evidence that the first thoracic and eighth cervical are not involved is seen in the fact that the cervical sympathetic is unimpaired, since the pupils are equal and there is no sinking in of the eyeball on the affected side. The fibers of the cervical sympathetic enter the cord through the first thoracic, sometimes the eighth cervical or second thoracic roots, so that when these roots are torn interruption of the cervical sympathetic fibers occurs. When this takes place there is a sinking in of the eyeball—enophthalmos—due to paralysis of Müller's muscle, with sec-

ondary narrowing of the palpebral fissure; contraction of the pupil—myosis—due to paralysis of the dilator fibers supplied by the cervical sympathetic, and to the unopposed action of the third nerve. This group of signs—enophthalmos, narrowing of the palpebral fissure, and myosis—is known as the Klumpke-Déjerine syndrome, and should always be looked for in any brachial plexus injury. Thus, as you see, I am stroking the skin of the neck; and those of you who are close may see that dilatation of the pupil takes place, showing that the sympathetic fibers are intact. This reflex is known as the ciliospinal reflex. Its presence places the lesion above the eighth cervical. Consequently, such a lesion as we have here can be accounted for only by injury of the fifth and sixth cervical roots above the clavicle.

The relation of the cervical roots to birth palsy was first pointed out by Duchenne, of Boulogne, in 1872; and two years later by Erb, in Germany, who cited similar cases in an adult as well as one in an infant. To Duchenne belongs the credit of having first localized the injury in the fifth and sixth cords, and that this deformity was due to a nerve lesion. Erb afterward located the lesion at the junction of the fifth and sixth cervical roots and at the point at which the suprascapular nerve is given off. This location (2 cm. above the clavicle) has since been called Erb's point (Fig. 226).

Neither Duchenne nor Erb attempted to explain the mechanism of the injury. Erb's explanation as due to traction of the fingers in the axilla during childbirth seems strangely at variance with his anatomic explanation. In this country the exact mechanism was not clearly shown until Taylor, Clark, and Prout (1905), in experimental and clinical work, showed that birth palsies of the Duchenne type were the result of any violence which forced apart the head and shoulder of the same side, thus stretching the cervical roots of the brachial plexus and in severe cases causing rupture of them. Taylor pointed out that rupture occurred first in the nerve root on which the greatest stretch was placed. These are, in the order named, fifth cervical, sixth cervical, seventh cervical, eighth cervical. The fifth, being the longest, is the most oblique and, therefore, is the first to give

way, thus accounting for the greater frequency of fifth and sixth cervical root types; though, as Taylor has pointed out, any or all of the roots may be torn. When the eighth and first dorsal roots are involved the paralysis is referred to as the Aran-Duchenne type. Cases are seen at operation in which the cervical roots are found sometimes completely torn apart.

It is difficult to see how anyone could conceive of this injury as secondary to capsular lesions about the shoulder-joint. The old view, before the work of Duchenne was known, was that these injuries were bony lesions of the humerus. Küstner

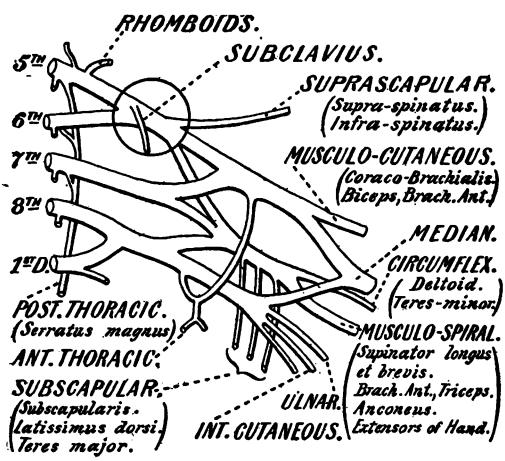

Fig. 226.—Schematic drawing of brachial plexus. Circle marks area usually involved in the Duchenne-Erb type of obstetric paralysis—Erb's point. (Binnie, "Operative Surgery.")

thought birth palsies to be due to separation of the epiphysis of the humerus; Whitman, the result of partial dislocation; and, more recently, T. Turner Thomas believes birth palsies to be due primarily to capsular lesions of the shoulder-joint, only secondarily involving the nerve in the vicinity by infiltration of blood and synovial fluid, with subsequent scar formation about the nerve.

No doubt at birth occasionally dislocation of the shoulder or separation of the upper epiphysis of the humerus, or other injuries to the shoulder-joint, may appear, as Küstner, Whit-

man, and T. Turner Thomas hold. However, the Aran-Duchenne-Duchenne-Erb, or the Duchenne-Erb paralysis alone, such as we have here today, obviously involving muscles supplied through the fifth and sixth nerve roots, can only occur as the result of an injury primarily to these roots above the clavicle.

Such an injury cannot result from any secondary injury to the shoulder-joint. *It would seem hard to account for a complete*

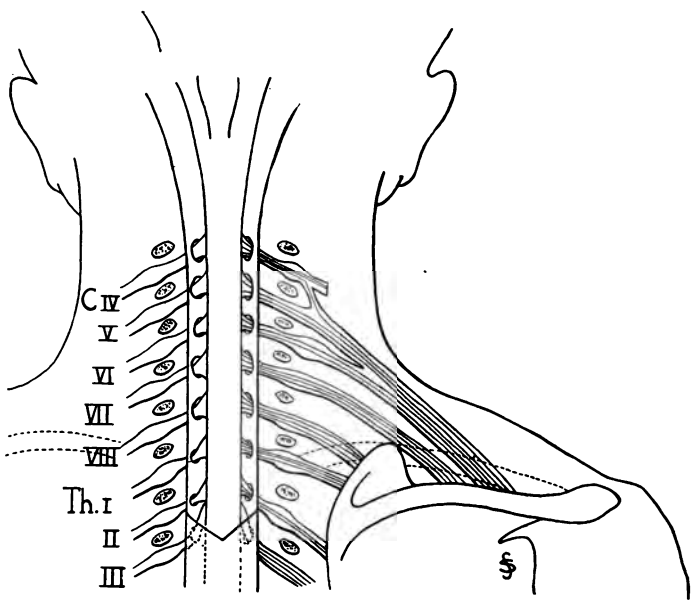

Fig. 227.—Schematic drawing of the brachial plexus as seen from behind, showing origin of the roots of the brachial plexus from the spinal cord. The vertebral arches have been cut away and the dura mater opened. The lines within the nerve trunks represent the funiculi.

anatomic interruption of one or all of the cervical roots as the result of the escape of synovial fluid from the shoulder-joint, and scar formation! To tear these roots considerable force is needed. Complete interruption of the cervical roots, one or more, is frequently found at operation upon these birth palsies. In no instance in which we have made the diagnosis of birth palsies and have operated have I failed to find anatomic evidence of injury to the nerve roots above the clavicle, as indicated by the

distribution of the motor paralyses which led to the diagnosis. Birth palsies of the type I have described here are due *primarily* to rupture, partial or complete, of any or all of the cervical roots which enter into the formation of the brachial plexus (Figs. 227, 228). Injury to the shoulder-joint may exist as a concomitant lesion, but injuries to the cervical roots in these cases are not secondary to injury of the shoulder-joint.

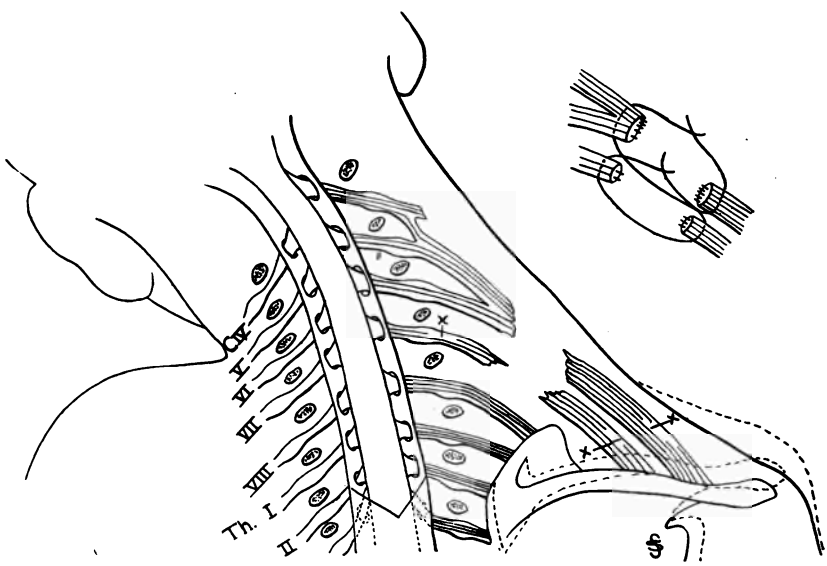

Fig. 228.—Same as Fig. 227. Schematic drawing to illustrate mechanism of rupture of the brachial plexus as seen in obstetric paralysis. The head is bent laterally beyond 30 degrees and the right shoulder lowered, thus increasing the acromiomastoid distance. The fifth and sixth roots are torn across at their junction; the seventh root is also torn. Note the irregular line of rupture of these roots, and also that the funiculi are torn at *x* within the nerve trunk, both distally and centrally. Insert shows sutures in place and nerve ends prepared for suture.

In this connection, it is interesting to note that similar palsies occur in adults as the result of trauma which forces the head and the shoulder violently apart, that is, increasing the acromiomastoid distance. I have at present 2 such cases: one, a young man of about twenty, who fell off a scaffolding only 10 feet high and landed on the right side of the head and the right

shoulder, thus inclining the head and neck forcibly to the left and the shoulder in the opposite direction. A paralysis resulted similar to a typical birth palsy, the same muscles being involved and the same characteristic deformity appearing, with the arm rotated inward and the hand facing backward. In the second case an Italian aged thirty was struck on the shoulder while at work as a construction foreman by a heavy stone which fell from one of the chains as it was being lifted off the wagon. The stone struck a glancing blow on the shoulder and immediate paralysis resulted, involving not only the fifth and sixth but also the seventh cervical roots. In neither of these cases was there any clinical evidence of fracture or dislocation at the shoulder-joint. In both of them forcible increase of the acromiomastoid distance resulted in paralysis similar to those seen as the result of obstetric paralysis. Thus a similar mechanism produced similar pathologic changes in both the infant and the adult.

You may ask me what should be the treatment of these cases from the moment they are first recognized.

As soon after birth as the paralysis is appreciated the arm should be placed in a sling or the sleeve pinned up to a cap, so as to prevent the arm from dragging down the shoulder and separating the nerve ends. A small pad should be worn in the axilla to raise the shoulder and thus tend to approximate the torn nerves. This position should be held until the child is two or three weeks old, at which time a splint similar to the one you have seen may be made, except that in the early stages of the injury the arm is carried more vertically, thus raising the shoulder and lessening the acromiomastoid distance. Such a splint can be made out of plaster or light metal, removable, so as to permit bathing and massage of the extremity. Both massage and passive movements should be done daily, and galvanism may be applied. If the case is thus treated, one may wait a year before interfering surgically. By this time the child is stronger and larger, and there is more room to work and less shock from the operation, though the scar between the nerve ends may become more dense.

You may ask how long one may wait expecting regeneration.

I would answer that if the case has been properly treated mechanically, delay of a year is not harmful. Unless sufficient time is awaited for regeneration to take place it seems unreasonable to delay three or four months and then to interfere. Such a time is rarely sufficient to admit of downgrowth of neuraxes. On the other hand, due to the nature of the trauma to the nerve ends in birth palsy, I do not believe each case should be operated as soon as the diagnosis is made, since the lesser injuries at first cannot be distinguished from the more severe, and the *lesser* may get well without operation. If then, delay is to be agreed to, it seems to me perhaps permissible to wait sufficiently long to allow of regeneration and not arbitrarily decide to wait three or four months. However, no set rule can be established, and each case must be judged by itself. To delay longer than twelve months, providing the case has been properly treated mechanically, seems to me unwarranted. In such cases, in which regeneration has not taken place, surgical interference is indicated. On the other hand, cases have been reported, which, however, I have not been able to verify, of nerve suture being done successfully ten years after injury, so that according to this view one need not despair of nerve regeneration even in the presence of a late operation. However, generally in prolonged paralysis the muscles have undergone retrogressive changes and there is little left for the nerve to innervate, even if down growth does occur.

When the nerves have been pulled apart, as they are in such a case as this—that is, by forcible separation of the head and shoulder—the injury to the nerve trunk is not sharply defined, since the funiculi may be pulled apart not only where the gross interruption of the nerve trunk occurs but also within the nerve trunk at various levels both within the central and the distal segments (Fig. 229); the funiculi may even be evulsed from the cord itself. For these reasons nerve suture offers the least favorable opportunity for regeneration when contrasted with incised wounds. In the latter, the funiculi in the central stump all have their central connections and those in the distal

are intact. However, when the nerve roots have been torn apart and have not reunited when placed—as the result of proper splinting—in a mechanically favorable position, operation offers the best possible chance of any success and consequently is worth attempting; yet the limitations due to the nature of the injury should be definitely appreciated.

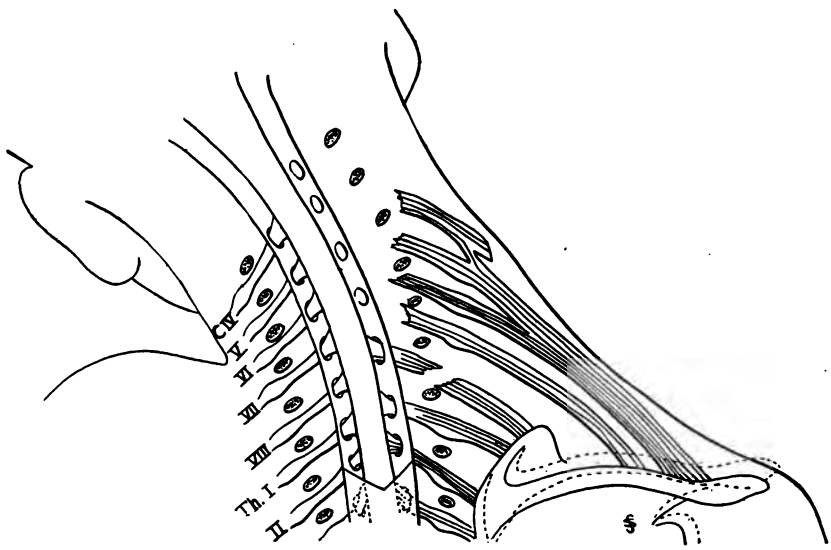

Fig. 229.—Same as Fig. 227. Schematic drawing, showing more severe type of injury to brachial plexus. The roots of the brachial plexus are shown avulsed from the spinal cord. The fourth, fifth, sixth, and seventh cervical roots are completely avulsed; the eighth cervical is torn across within the intervertebral foramen; and the first thoracic shows rupture of the funiculi from the spinal cord, while the outer continuity of the nerve trunk is still maintained.

Before proceeding with the operation it might be well to remind you briefly of the anatomy of a peripheral nerve and a few points concerning nerve regeneration.

The unit of a peripheral nerve is the nerve-fiber or neuraxis. These are the axons of anterior horn cells (motor fibers) or the peripheral processes of the cells of dorsal ganglia (sensory fibers), as well as fibers from the sympathetic ganglia which enter the nerve through gray rami communicans.

The nerve-fibers within a nerve trunk are divided into those having a medullary sheath and those without such a sheath. The former are called medullated fibers; and those without the medullary sheath, non-medullated. Surrounding the non-medullated nerve-fibers and the medullary sheath of the medullated fibers is a thin outer layer having an oval nucleus on its inner surface. This layer is called the *neurolemma*.

Both medullated and non-medullated fibers are grouped together within the peripheral nerve in bundles, termed *funiculi*, having a connective-tissue sheath which is called *perineurium*. The individual fibers of such a funiculus are separated from each other by a connective tissue called *endoneurium*, and the funiculi are bound together, forming the peripheral nerve, by an outer dense connective-tissue sheath, called the *epineurium*. Thus the *epineurium* is the outer sheath of the nerve trunk; the *perineurium*, the sheath which surrounds each funiculus; the *endoneurium*, the sheath separating each nerve-fiber; while the *neurolemma* is the thin fine nucleated sheath surrounding both the non-medullated fibers and the medullary sheath of medullated fibers.

I have gone only briefly into detail so as to give the correct terminology in speaking of nerve suture and nerve repair. Frequently one sees the term "neurolemma suture" used, whereas epineural suture is meant. Neurolemma suture obviously is not possible, since it would mean a suture of the sheath of each individual nerve-fiber.

I might briefly remind you that formerly two views of nerve regeneration were held: one, that the nerve-fibers regenerated in the peripheral nerve segment of the severed nerve, without necessarily down growth from the central stump taking place; the other, that regeneration occurred *only* as an outgrowth from the neuraxes of the central stump, the distal stump serving principally as a series of conducting tubules for the outgrowth of the neuraxes from the central stump. This latter view has been proved by numerous investigators, notably Huber, Ransom, and others, and is the only one now accepted. Thus, if a nerve is severed, the neuraxes in the distal stump undergo fragmenta-

tion and absorption, while those in the central stump divide and begin to grow out toward the peripheral stump. A single neuraxis may form ten to fifteen branches, each of which may grow out and attempt to find the peripheral stump, the latter serving as conducting tubules for the down-growing neuraxes.

It has been asserted that downgrowth of neuraxes takes place at the rate of 1 to 2 mm. per day. Thus, the more central the injury, the greater the distance the neuraxes must grow. However, the more distal the injury, the less the power of regeneration there seems to be, though this has not been definitely proved; so that an injury to the distal part of a nerve may require as long or longer for regeneration than if the nerve were injured more centrally.

Operation.—We will now proceed with the operation. The infant is wrapped in warm blankets and surrounded by heaters so as to prevent shock. The operation must be done in as short a time and with as little loss of blood as possible. If all bleeders are promptly grasped and bleeding reduced to a minimum, the probability of operative shock will be lessened.

The exposure is the same as in the previous case. I am now down upon the deep cervical fascia. It is thickened over the fifth and sixth cervical roots. Perhaps the cervical fascia was torn at the same time the nerve roots were injured. I am freeing the nerve roots from the surrounding scar, due greatly, perhaps, to the escape of blood *from the nerve ends* when they were torn, *not* blood or synovial fluid from the shoulder-joint. Here is the fifth root completely torn across. Note its enlarged end, due to the persistent effort of the neuraxes at regeneration. Here is the sixth root, also torn across—no, here is a small band connecting it with the distal part. I am following this to the distal segment. This band is only scar tissue. I am putting gentle traction on the distal segment so as to mobilize the distal end. When traction is being applied it should only be applied to the distal segment, and only slight traction is permissible. This should always be done at the distal end only, thus avoiding injury to the central stump, since the latter is the source of regenerating neuraxes. The distal stump is now freed, and I am

excising into it so as to obtain a cross-section in which the funiculi may be seen, and in which scar tissue is absent.

I am now freeing the central and am excising into the central stump of both the fifth and sixth roots. We have now a good cross-section in both, though the fifth is torn near the intervertebral foramen. The funiculi are plainly visible in both. They appear as small tubules and stand out distinctly. Good cross-areas must be obtained both above and below in order to facilitate downgrowth of the neuraxes.

The shoulder is being raised so as to allow approximation of the nerve ends. I am placing one through-and-through catgut suture, and the others are epineural sutures of fine silk. End-to-end apposition is now obtained, but is not so perfect as we should like. In an infant we cannot spend so much time as in an adult, nor when the shoulder is raised can we work readily in the wound, since most of the space is obliterated by the position of the arm.

The wound is now closed in the usual manner, and dressing and splint applied. The splint is always made before the operation and properly fitted, so that it can be applied at once. The splint is designed to hold the arm almost vertically and thus insure elevation of the shoulder, thereby diminishing the distance between the acromion and mastoid, and thus helping to approximate the nerve ends. The arm is kept in this position for three weeks, and is then gradually lowered to a right angle.

We shall not expect much improvement in less than a year, since it should be remembered that the neuraxes must grow out from the central stump and make the motor and sensory connections distally. It is always well to explain this to the parents beforehand, and to insist upon continuing mechanical treatment as well as massage and electricity.

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